September 1993 Issue #26

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Radio Fun

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"The beginner's guide to the exciting world of amateur radio."

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Ticket Time

The FCC's enforcement division has been busy lately. Three Los Angeles area amateur radio equipment dealers have received Notices of Apparent Liability (NALs) in the amount of $7,000 each for marketing the Kenwood TS-50S HF Transceiver which could be ". . . operated on frequencies not authorized for amateur radio use." The complaint apparently stems from a brochure which originaly mentioned the rig's ability to operate above and below the ham bands. This brochure has since been reprinted showing only the rig's ham-band capabilities.

Four out-of-band CB operators are being fined from $2,000 to $3,500 each for their infractions. A fat $10,000 fine has been levied against Lonnie N. Gwinn of Federal Heights, CO, for selling external CB RF power amplifiers at a truck stop.

Margaret G. Taylor of Windermere, FL, was told she owed the government $2,000 for her unlicensed amateur radio operation.

Four computer companies were ordered to cough up from $7,000 to $10,000 each for marketing personal computers which did not have the proper FCC equipment approvals.

The Southern Railway Company was fined $7,000 for refusing to allow an FCC inspection of their radio base station. *TNX W5YI Report, Issue #14, July 15, 1993.*

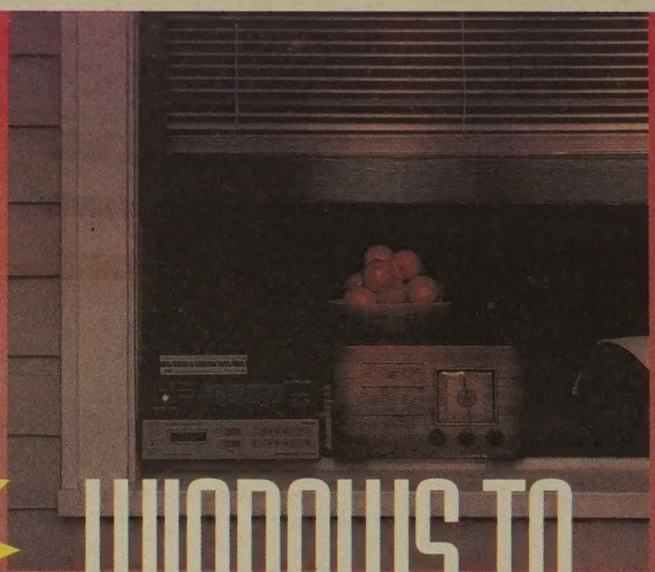
Quick Charger Extends Battery Life

A small Austrian company—Enstore R&D GmbH in Graz—has come along with a quick charging technology which not only does not harm batteries, but may actually extend their usable lifespan. A new chip is used to monitor the state of the battery's charge during the recharging process. Doing so allows the charger to feed the battery as much current as it can handle without causing heating or gassing.

The Enstore electrode-specific charging system (ECS) is touted as the solution for the dreaded memory effect suffered by NiCd batteries. Enstore claims the ECS can extend the useful life of a NiCd battery to 5,000 charge-discharge cycles from a typical average of 500 cycles. Application for the new technology is likely to spread from small hand-held electronic devices to electric cars. *TNX The Institute of Electrical and Electronics Engineers:The Institute Vol. 17, July/August, 1993.*

DANGER: High Voltage

This remarkable photograph of a lightning bolt striking a sycamore tree was taken by Johnny Autery of Dixons Mills, Alabama, from his pickup truck. Two upward flashes can also be seen connecting to the main bolt: one from the left side of the tree, and one from the TV antenna on the left. (See "Lightning Strikes!" on page 16.)



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by Wayne Green W2NSD/1

How I Got a Free Trip Around the World, Hamming All the Way!

I was envious when I heard about the proposed Operation World-Wide. This was an around-the-world trip aboard a C-54 MATS plane. The time frame was 1959 and I was the editor of *CQ* magazine. One of the hams going on the trip was Bill Leonard W2SKE, later the head of CBS news, a chap I'd known for several years. I called Bill to get more information about the trip and found that the other ham operator planned for the flight was going to have to cancel out. Health reasons. I quickly volunteered to replace him.

What had happened was that the Pur-Pak division of Ex-Cell-O Corporation of Detroit, the people who make most of our milk cartons (the ones that say "open here"), wanted to do a film of their worldwide operations. Their PR head was Ralph Charbeneau W8OLJ. He cooked up a deal with the Military Air Transport Service (MATS) where they would supply a plane and flight crew for the trip and Pur-Pak would provide the film crew. The crew would do a film about the MATS operation as well as their milk carton plants in exchange for the flight. So why not put a ham rig aboard and a couple ham operators and get some extra promotion? Sounded good to me. That's a trip any ham would give his eyeteeth to make.

Despite Ralph turning out to be an insufferable overbearing asshole, I had a fabulous time. We took off from McGuire AFB in New Jersey, heading for Newfoundland. We had a brand-new Hallicrafters FPM-200 transistorized SSB transceiver. One of their prototypes. Naturally it crapped out soon after we took off. Fortunately we had a second prototype with us so our Hallicrafters tech, Bud Drobish W9QVA, switched to the live rig and we carried on. For a while, then pffft!

Not daunted by transistors, I suggested we see if we could fix the rigs. Bud explained that (a) he had no schematics for them, (b) he had brought no test equipment, (c) the transistors were all soldered in place on the prototypes, and (d) he had no spare transistors along anyway. So we replaced the dead 200s with an old reliable SX-101 receiver and an HT-32 exciter with an HT-33 amplifier and at the next stop shipped the 200s back to the factory for repairs. We didn't see them again until near the end of the trip.

The C-54 had been used in the Berlin airlift, so it was an old and slow plane. It lumbered along at under 200 mph and was unpressurized, so we couldn't fly very high either. Never mind the slowness, I had the time of my life operating 15 & 20m as we flew. We took the trip in short, easy hops, mostly staying overnight at Air Force bases or nice hotels as we went. In countries where we were filming milk plants and MATS operations we'd stay two or three days. The first stop was Newfoundland, as bleak a spot as you could ask. Then off to Bermuda. Then we had a great visit to the Azores. The milk was delivered by the farmers in donkey carts there.

Thence to Prestwick Scotland, up near Glasgow, where a local ham showed me all around the area. From there we flew to Paris, where we spent several days. Next stop Berlin. Then on to Haderslev, Denmark, where I had a great visit with OZ4EA. Back to Paris for a couple more days and then on to Rome. There six of us rented scooters and had a wonderful time zooming all around the city. They introduced me to the Tres Scalini restaurant, which I've visited on each subsequent trip to Rome . . . like one four months ago.

In Athens we did all the usual sightseeing, then on to Izmir, Turkey. While they were filming I went sightseeing and buying souvenirs. I've still got one of the puzzle rings I bought there. Then on to Alexandria, Egypt. I'd have rather visited Cairo and the pyramids, but I did manage to do that on a couple of later trips.

We were going to stop in Djibouti, where my good friend F9MH, the French consul in New York, had gotten me a local license, but the airport wasn't big enough, so we went to Aden instead. Robin VS9HA met our plane in the wee morning hours and let us catch up on our sleep in his apartment. Later we got on the air with his rig for a few contacts, and then he showed us the nearby Queen of Sheba's water catchments. Impressive.

From Aden we flew to Karachi, where a ham I'd last seen at a Houston hamfest met me at the airport. He'd heard me talking on 20m about the visit. Then on to Sri Lanka and a wonderful visit with Soma 4S7YL and her daughter Chitra. I fell in love immediately. I was impressed by the elephants mixed in with the cars on the roads, mahouts urging them on.

Bangkok was next. They still had opium dens, but much as I wanted, I didn't have an opportunity to visit one. I was impressed by the beauty of the temples and their selling roasted giant cockroaches for use on their curries. Gives their curry a bitter flavor they seem adjusted to. I like my curries hot, but not bitter or rotten, like Bombay Duck (bumalo fish) flavors it. We left with bags of fresh leeche nuts. Mmmm.

Vietnam was just a short flight away . . . couple of hours. We had to circle for a while as the airport was being shelled when we arrived and we had to wait for the Viet Cong to stop. I know you'll find this difficult to believe, but the film crew suddenly decided to skip filming there, so we didn't stay very long. From there it was only a couple more hours to the Philippines. I got some great pictures there of the pygmies living near the air base, and Angeles, the small rural town nearby.

Another short flight and we were visiting Taipei for a few days. I visited Taipei 20 years later and was amazed at how it had grown. We had some great meals there and I probably should tell you some day about the hillside a few miles from the city where all their "houses" were. Well, maybe not.

From there we flew to Okinawa, which was American-controlled then. Eventually we gave it back to Japan. Then on to South Korea for a couple days. One of our film crew got the clap there from an attractive housekeeping gal. Tsk. Then el biggo, Tokyo. We stayed at the Frank Lloyd Wright-designed Imperial Hotel, near the Ginza. I had a fascinating adventure there, but that's going to have to wait for my memoirs. Heh. Work was so scarce at that time that when we put our shoes out at night to be polished, one man did the right shoes and another the left, just to give more jobs. I think the yen was 360 to the dollar. It's now around 110.

From Tokyo we flew to Guam. I hadn't been there since 1945, when I spent a couple weeks at the submarine rest camp. Bud was in heaven when we got to Guam . . . hamburgers. He was not into Thai, Vietnamese, Philippine, Chinese, Korean, or Japanese food, so he'd been having a tough time. I eat almost anything and love it.

We stopped off at Wake Island for a day. Bleak place. They had the highest ham per citizen ratio of any country in the world. I took a picture of the "main street" with ham beams on just about every other house. Well, what else is there to do on Wake? No TV. No radio, other than shortwave.

We spent several days in Hawaii. I visited the local dive shop, rented an Aqua-Lung and went out with a sightseeing boat. They dropped me off near Diamond Head and said they'd pick me up in about 40 minutes. The water was only about 80 feet deep, but there was one tiny little problem. This was before we had pressure gauges on our tanks. There was a rod you pulled when you started running out of air and this gave you an extra five minutes to surface. The problem was that I ran out of air immediately. They had forgotten to fill my tank! This was before the days of buoyancy compensator vests (BCs) too, so I had to desperately tread water for 40 miserable minutes until the boat finally came back. This wasn't easy, considering the dead weight of the tank and my weight belt. No, I didn't have a diving partner. That convention hadn't really taken hold yet. And, no, I'll never forget any one of those 40 minutes.

Next stop was California, then a gasping flight over the Rockies. I sure noticed the lack of oxygen in the unpressurized old plane. The slightest movement exhausted me. It was almost enough to keep me from making contacts as we flew. We stopped off in St. Louis and then ended at McGuire again. We'd flown 28,500 miles and had been in the air 145 hours. We'd visited 24 countries and made well over a thousand contacts, mostly on 20m. Ralph hadn't bothered to get us licenses to operate in most of the countries we visited, so we had to stop transmitting when we were approaching land. The pilot needed to be able to use his radio then anyway, so we'd shut down.

Bill W2SKE and I had a great time on the trip, hamming and sightseeing. And I've told you about Ralph, who did little to enhance the experience. I was so damned mad at him that I refused to write about the trip. I eventually published a short article by Bill.

It was fun getting back to Taipei, Seoul, Tokyo, and the Philippines 20 years later. Amazing growth and changes.

Since then I've gone around the world four more times, but that was the first and an experience I'm sure glad I pushed to do.

We had a tape recorder going during the whole trip. I suppose the cartons of tapes were thrown out when Hallicrafters went bust as a result of the ARRL's Incentive Licensing proposal four years later. But Hallicrafters did put out a 45 rpm record pushing shortwave listening, "Tune In The World." I remember I was driving along Coney Island Avenue in Brooklyn in my little Porsche Speedster. I had a Philips 45 player in the car and suddenly there was my voice, talking with a good friend of mine in Romania as I was flying over the Indian Ocean. Hey, that's me! The big fat guy smoking a cigar in the Cadillac next to me at the light didn't seem interested. RF

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Inductive Reactance

by Larry Luchi W7KZE

[Editor's Note: This technical discussion of inductive reactance is a bit more advanced than what we usually publish in Radio Fun*, and it may leave some of you in the dark. If so, read it through a few times—slowly—and things should begin to sink in. If you want to get the most out of amateur radio, you've got to really understand this stuff—not just memorize a bunch of answers for a test. We've asked Mr. Luchi to prepare a set of articles focusing on various electronic components and their properties. We'll publish them from time to time, and if you stick with them, you'll be well on your way to a solid foundation in electronics.—David N1GPH]*

In the August 1993 issue of *Radio Fun* I discussed capacitive reactance. You were introduced to my calculator math approach to solving the problems found in the General, and especially in the Advanced Class, amateur radio exams. I teach a Thursday night General/Advanced licensing class. More than 1,000 students have upgraded successfully in my program. This article is from my lecture on inductive reactance, the opposition that a coil has to alternating current. Symbolized by X_L, and pronounced X sub L, this opposition to the flow of AC is different from ohmic resistance because it results from the back voltage of a coil rather than atomic collisions within the material (as in a capacitor). Since it depends on back voltage, X_L changes when frequency changes. As a very crude example, an inductor behaves like a frequency-dependent resistor. But it is unlike a resistor where voltage and current are in phase. In an inductor, the voltage and current are 90 degrees out of phase. Like a resistor, inductive reactance is measured in ohms.

Basic Ideas

A time-varying current through an inductor produces a back voltage across the inductor. For this reason, an inductor has different effects on direct current and alternating current.

Effect on Direct Current

Figure 1a shows a DC source applied to an inductor in series with a resistor. If the inductor is ideal (meaning that it has no resistance), it gives a current of 10 volts divided by 1kΩ, or 10 mA. In this DC circuit, the inductor has no effect on the direct current. In general, whenever the DC resistance of the inductor is much smaller than the total resistance of the circuit, the inductor has essentially no effect on the direct current. The voltage drop is mostly across the resistor.

Effect on Alternating Current

Figure 1b shows the same circuit with an AC source. Because the current through the inductor is alternating, a back voltage is induced across the inductor. That is why some of the applied voltage is dropped across the inductor. This means that less voltage appears across the load resistor, which results in less current. The amount of voltage dropped across the inductor can vary from 0 to 10V in Figure 1b, depending on the frequency of the AC source and the inductance.

The point is that an ideal inductor opposes alternating current but has no effect on direct current. The higher the frequency or the larger the inductance, the greater the opposition to alternating current.

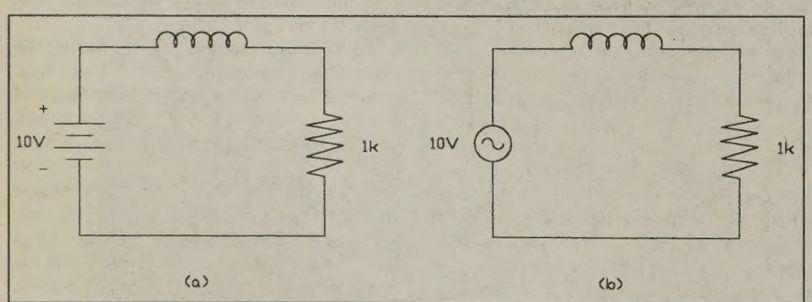

Figure 1. The effect of inductance on (a) direct and (b) alternating current.

Definition of Inductive Reactance

Inductive reactance is the opposition that an ideal inductor has to the current through it. For an ideal inductor, the defining formula for inductive reactance is:

$$X_L = \frac{V_L}{I_L} \qquad \text{Equation 1}$$

Where X_L = inductive reactance
V_L = rms voltage across the inductor
I_L = rms current through the inductor

Equation 1 is valid only for sinusoidal voltage and current where V and I are the rms values of the sinusoids. Since peak values and peak-to-peak values are directly proportional to rms values, Equation 1 is also valid for peak values and for peak-to-peak values.

For instance, if V_L = 10 volts and I_L = 1 mA, the inductive reactance is:

$$X_L = \frac{10V}{1mA} = 10k\Omega$$

The corresponding peak values are 14.1 volts and 1.14 mA. The peak values are found by dividing the voltage and current by the cosine of 45 degrees, or 10 divided by 0.707, and 1 divided by 0.707, to give us the rms values. The inductive reactance is then easily found using Ohm's law:

$$X_L = \frac{14.1V}{1.41mA} = 10k\Omega$$

How L and f Effect X_L

The two critical factors that control the inductive reactance are the frequency of the source and the inductance. This makes natural sense: Increasing the frequency means the magnetic field changes faster; increasing the inductance means the changing field has a greater effect.

The inductive reactance is directly proportional to the frequency and to the inductance. For instance, if the frequency is doubled, the inductive reactance will double. If the inductance is tripled, the inductive reactance will triple.

Formula for Inductive Reactance

With calculus, the following formula can be derived for the inductive reactance:

$$X_L = 2\pi fL \qquad \text{Equation 2}$$

Where X_L = inductive reactance
f = frequency
L = inductance

This formula is useful when you know the values of frequency and inductance. Notice that X_L is directly proportional to f and L. Stated another way, X_L is linear with respect to f and L—this is apparent from the linear formula of Equation 2.

As before, sinusoidal voltage and current are suggested. In other words, Equation 2 gives you the opposition of a coil to the sinusoidal current through it when there is a sinusoidal voltage across it.

A final point: Direct current does not change directions. It has no frequency. This is mathematically equivalent to saying direct current has a frequency of zero when used in Equation 2. To calculate the inductive reactance for direct current, you would substitute f = 0 into Equation 2. This would result in X_L = 0.

Calculating f and L

Equation 2 contains three variables: X_L, f and L. Given any two of these quantities, you can solve for the third. For instance, if you know the values of f and L, you can substitute into the equation and calculate X_L.

On the other hand, if you have the values of X_L and f, you can rearrange the equation to solve for inductance, L:

$$L = \frac{X_L}{2\pi f}$$

After substituting the values of X_L and f, you can calculate the value of L.

A third possibility is knowing the values of X_L and L. In this case, the equation can be rearranged as:

$$f = \frac{X_L}{2\pi L}$$

After substituting for X_L and L, you can solve for f. When using Equation 2 with a calculator, use the [EE] or [EXP] key for the exponent (power of 10). Your calculator will then default to a positive exponent. The sign change key [+/-] will change to a negative exponent for millihenries (10^{-3}) or microhenries (10^{-6}). Practice with the following examples:

Example for X_L: Inductor = 6 mH and frequency of 41.67 kHz

$X_L = 2\pi FL$

ENTER	DISPLAY
6.28 [X] 6 [EXP] [+/-] 3 [=]	0.03768
[X] 41.67 [EXP] 3 [=]	1570.1256 X_L = 1570Ω

Example 2: An inductor = 43 mH, frequency 3.625 MHz, what is the inductive reactance?

ENTER	DISPLAY
6.28 [X] 43 [EXP] [+/-] 3 [=]	0.27004
[X] 3.625 [EXP] 3 [=]	978.895or 979Ω

(Remember that an ideal inductor stores energy in a magnetic field. In an ideal inductor, current (I) lags the voltage (V) by 90°.)

In my next article we will look at resonance, the combination of X_L and X_L. RF

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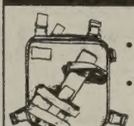

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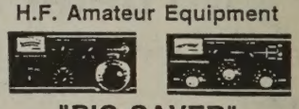

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letters

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Steve Cates KC6TEV, Sacramento CA I just called your toll-free number and subscribed to *Radio Fun*. I have been scrounging copies from my Dad, WA6GER, since issue #1. This has been a better deal than your offer of $12.97. However, as reliable as parents can be, an occasional copy has been missed, or an article has been cut out. This was OK until the May, June and July 1993 issues came out. In May, the "Radio Magic" column by Michael Bryce caught my attention. It was *superb!* The detailed instructions on the keyer project were just what I needed. All of the hints were great: how to position components, how to solder them in, troubleshooting, what the components do in the circuit, etc. I have built kits before, but have always been slowed down by questions such as, "How high should a component be positioned above the board?" or "Which way should the chip go in?" Not so with this project. All the info was there. I'm fortunate to have immediate access to several Elmers and to work with an electronic technician who is also a ham. Most amateurs are not so lucky. It's the little details that hold them back on starting a project. Many have never used a soldering iron and don't know the most elementary techniques. Others, like myself, have some experience, but still lack the confidence to plug ahead. Usually, about half the time I spend on a project is spent on the telephone or on packet trying to get the information that was in these articles. Not so with this one.

I showed these articles to several home-brewing hams who have been licensed for 20+ years. They too thought the articles were great and even they picked up a few pointers.

By the way, I bought the keyer kit and intend to build other projects that Mr. Bryce writes about, as long as they continue to include the detail contained in the May-July columns. *I will also continue to subscribe to* Radio Fun *as long as articles like these keep coming.*

I also particularly like "The Tech Side" column and would like to see a column on QRP basics. A QRP column could be used to complement "The Tech Side," "Radio Magic" and other columns such as the vintage reviews, antennas, etc. QRP is particularly appealing to new hams because it can be an inexpensive entry into project construction and provide a practical, hands-on, radio electronics education.

Michael A. Czuhajewski WA8MCQ, Severn MD In a recent issue (March 1993), Morgan Godwin W4WFL wrote "Confessions of a Low Power Freak." In it he mentioned that at one time the QRP Amateur Radio Club International (or QRP ARCI) had a 100 watt power limit, and said that it may still use that limit.

As a member of the Board of Directors of the QRP ARCI, and a writer and columnist for the *QRP Quarterly*, I would like to make it known that we have been using the now-universally-accepted QRP "legal limit" of 5 watts for about 14 years. The "QRP club" has long since turned into a real QRP club! Here is an extract from our "History, Purpose and Policies" statement, which I wrote and which now appears in every issue of the *QRP Quarterly:*

"The QRP ARCI was founded in 1961 by the late Harry Blomquist K6JSS, with the aim of reducing QRM on the air by members voluntarily limiting their power to 100 watts or less at all times. Due to increasing interest in true low power operation and through the leadership of then-President Tom Davis K8IF, the Club voted in the late 1970s to redefine its purpose in that direction, and

Continued on page 13

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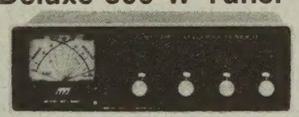

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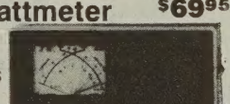

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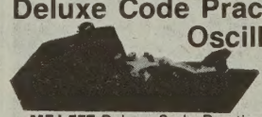

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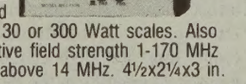

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CIRCLE 86 ON READER SERVICE CARD

A Primer on Repeaters

by Steve Katz WB2WIK/6

Now that you're licensed—or even if you're still working on your first ham ticket—you'll need to know something about FM repeater systems. Repeaters can be used by all amateur radio operators. Maybe you have no desire to use repeaters, or perhaps they are the main attraction which got you into ham radio. Either way, this article is for you. After all, a repeater could save your life some day.

Rather than rehashing everything that's already been written about repeaters, let's examine the fundamentals in three categories: electronics and equipment, site selection, and repeater operation.

Electronics and Equipment

It is best to start out with a key principle: that repeaters are intended to extend the communications range of mobile and portable equipment. This is their sole function. Repeaters are not toys for rag-chewing between base stations which could easily switch to a simplex channel and continue a conversation. Someone or some group is financing the operation of every repeater on the air, and these costs can run into thousands of dollars per year. Whoever owns the repeater may be paying a monthly or quarterly site-rental fee (and the best-sited repeaters usually have fees associated with their sites), but even if this isn't the case, repeaters cost money to maintain, repair, and for the electric power they consume.

The typical repeater is a single-band, full-duplex system which uses a receiver, a transmitter, a controller, an antenna and duplexer (or possibly two antennas without the duplexer), a transmission line or lines, and peripherals like power supplies, autopatch systems and transmitter power amplifiers. The retail cost of a simple but workable repeater system is at least two thousand dollars, plus ongoing expenses. Some repeater systems, especially the sophisticated ones with multiple receivers, split-band operation, elaborate autopatch controllers, and so forth might cost well in excess of five thousand dollars. I mention prices and costs only to keep the reader aware that misuse, overuse or abuse of the system can create substantial additional cost for the owner(s).

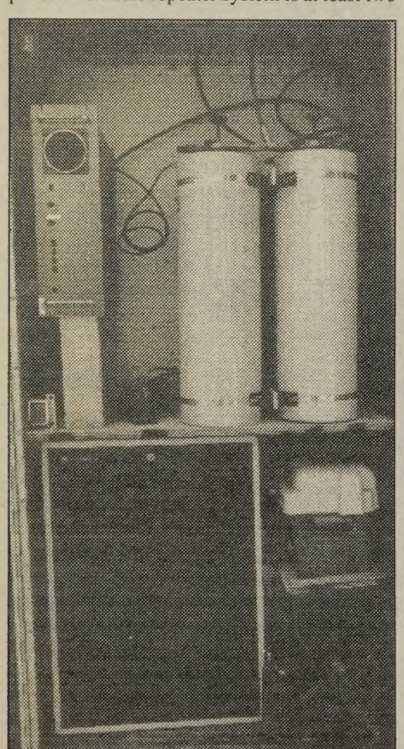

Photo A. A simple repeater system. The ICOM 50 watt 2 meter repeater is mounted on its side in the upper left portion of the cabinet. A large WaCom duplexer is seen at the right. Below is a 12 volt battery for emergency power and lower left is a Motorola 450 MHz commercial repeater.

What makes a repeater receiver and transmitter different from an ordinary ham transceiver? Quite a bit! Obviously, the repeater transmitter might be called on to transmit continuously for days at a time and must be capable of doing so without failure. The average amateur mobile or base rig can't do this. The receiver must be capable of receiving very weak signals in the same band as its transmitter is working, often on a frequency that is very close by the transmit frequency. A typical 2 meter repeater might have an input-output frequency offset of just 600 kHz. This is a frequency "split" of just four-tenths of one percent of the operating frequency. An ordinary ham rig's receiver will not tolerate a powerful transmitter operating only 600 kHz away from its receiving frequency and at the same time using *the same antenna*, or an antenna in very close proximity to the transmit one—it would suffer "terminal desense," jargon used to describe what really happens in these situations when non-repeater equipment is used. The receiver, which is not designed to operate immediately adjacent to a powerful transmitter operating simultaneously in the same band, will simply overload to the point that its sensitivity on the desired channel frequency will be terrible.

To allow this kind of operation, repeater receivers are usually extremely well-shielded and electrically decoupled from the transmitter, and use very narrow passband RF preselective filtering which rejects energy on all but the desired frequency. A common amateur mobile/base unit doesn't have these features. Repeater receivers and transmitters also need to be more frequency stable than the ordinary rig because they need to stay on frequency for long periods of time over great variations in ambient temperature—unless the repeater owner is lucky enough to find a site where he can put his equipment in an environmentally-controlled room that has heating and air conditioning (these sites are highly desirable but can be very costly or impossible to find). Many repeaters are located on nearly inaccessible mountaintops where temperatures might range from 30 degrees below zero to more than 100 degrees above zero with seasonal changes. The average mobile/base rig won't hold frequency very well over these extremes.

To allow transmission and reception with a single antenna, repeaters often use a filter network called a *duplexer*. Duplexers vary in design, but the most effective ones can be bulky and expensive because they are made from several RF "cavities," which are highly selective filters that appear to be nearly lossless on the desired frequency and have enormous rejection at a specific undesired frequency. A typical 2 meter single-band, full-duplex repeater system (which most are) might employ four, six, or even eight such cavities in the duplexer, depending on transmitter power and desired results. A good commercially-made duplexer can cost in the range of $1,000, and they are not easily home-brewed because of the precision machining required.

Say you have a repeater with an input (receive) frequency of 146.34 MHz and an output (transmit) frequency of 146.94 MHz. To use a single antenna for this repeater, you'd need a duplexer that passes signals at 146.34 MHz through to the receiver with minimal attenuation, but has tremendous loss at 146.94 MHz to avoid destroying the receiver's sensitive RF stages from the powerful transmitter operating with the same antenna. The same duplexer would need to pass the transmitter's output signal at 146.94 MHz through to the antenna with minimal loss, but greatly attenuate energy at 146.34 MHz, where the transmitter's "noise sidebands" would be intense enough to cause receiver desensitization. The duplexer described would need to have *two* sets of cavity resonators, with each set tuned differently to accommodate the functions discussed above. A four-cavity duplexer would usually have two cavities in the receive section and two more in the transmit section. A six-cavity duplexer would normally divide up the task in groups of three. This isn't a firm rule as each system may be designed differently.

Some repeaters use separate transmit and receive antennas; if these are spaced far enough apart, they may not require a duplexer at all. But then these systems have the added cost of a second antenna and transmission line, plus a support system for a second antenna. Plus, they often don't have "reciprocal coverage" of the transmitter and receiver because of the separate antenna locations. As such, a repeater owner usually isn't saving much by using two antennas, and may be sacrificing some performance. On the other hand, some two-antenna repeaters work great because the duplexer *losses* are eliminated.

A repeater also needs some sort of "*controller*" to activate its transmitter on receipt of an input signal, to automatically identify transmissions, and so forth. To accommodate FCC Part 97 regulations, a controller can be quite simple and really only needs to identify the transmissions every 10 minutes or less, and have a "fail-safe" timer which will shut off the transmitter after three minutes in the event of a malfunction, a jamming input signal or whatever. But most repeaters have controllers more complex than this to help make the system work smoothly.

At the very least, a controller should have a "carrier-hang timer" which keeps the repeater keyed a bit longer than the input signal is present, so that the repeater's transmitter doesn't key on and off rapidly in the presence of a fluttery mobile input signal. A repeater without a hang timer is almost worthless for anything but very strong-signal work. Controllers also usually allow the repeater owner(s) or control operator(s) to turn the system on and off from a remote location. So that everyone in the world cannot control the repeater, often this "control input" is on a different amateur band authorized for such use. If so, the repeater needs a second receiver and antenna for that band, along with a decoding circuit (usually DTMF "touch-tones") to perform the desired functions. Of course, *local* control is allowed (where the control operator is physically present at the repeater site), as is control via "landline" (telephone) or "hard-wire" (direct, wire control connection between the repeater and the control operator).

Technically, a repeater must be under the control of a responsible owner or assigned control operator at all times to assure that its operation remains lawful. The repeater licensee is responsible for the lawful operation of his or her repeater system and can be cited for violation by the FCC if the repeater is operated in an unlawful manner. Usually, the FCC would only become involved if there were written complaints, and well-documented ones, about its operation. The most common complaints which might require FCC intervention are regarding interference with other services. The Amateur Radio Service is supposed to be largely self-policing, and we have repeater coordinating organizations located throughout the country to help administrate repeater operations.

Some sophisticated repeater controllers contain an "*autopatch*" which allows remote-control operation of a telephone patch connected to the repeater equipment, so that mobile/portable users can make *non-business* telephone calls for any purpose through the system. This is a neat feature, and is not new by any means. Unfortunately, it is easy to get carried away with autopatch operations, and for many years, lots of users made totally frivolous telephone calls via amateur radio. The telephone companies and cellular system companies hold amateur radio autopatch systems in great contempt, since our use of ham autopatch would seem to cost them business. With the advent of affordable cellular telephones that are no larger than a handie-talkie, and recent reductions in cellular telephone service rates, I believe amateur autopatches are approaching the point of outliving their usefulness. But they still exist, and probably will for some years to come, unless regulations change to make their use unlawful.

An autopatch basically connects the telephone line, which is already full-duplex (it can transmit and receive simultaneously), to a full-duplex repeater system. This is a simple audio interface and connection and does not require any RF circuitry. But *controlling* the autopatch can require sophisticated electronics, with touch-tone decoders (and sometimes encoders which re-dial numbers into the telephone line), timers, and so forth. Many autopatch systems have subscriber identification numbers and telephone number memories so that frequently-called numbers may be accessed by the user pressing only two or three digits on his mobile/portable touch-tone pad. This is similar to "speed dialing," available on many telephone systems.

Some repeaters even employ a "reverse-patch" which allows someone to call the repeater on the telephone (rather than on the air) and generate a signal which alerts listeners that a call is coming in. Then, a user can activate the autopatch with predetermined remote commands (usually touch-tone) and quite literally answer the phone over the air. There is considerable controversy regarding the legitimacy and lawfulness of these operations, since it is possible that an unlicensed person, by calling up the repeater, can initiate an amateur radio transmission and control the repeater's transmitter. There are still systems out there using a reverse patch, but I'd recommend against it. There are too many potential problems, regardless of the letter of the law.

Site Selection

Repeaters, in order to serve any useful purpose, ought to be located in places that are good VHF/UHF radio locations and are "line-of-sight" to a great many potential users. If a repeater's location isn't any better than the average mobile user's, there wouldn't be any reason to use it, since it wouldn't allow for extended-range communications.

As such, most repeaters are on mountaintops, hilltops, tall buildings, or tall towers. If you're lucky enough to live at a great radio location, your own home might make a good repeater site! But this is surely the exception and not the rule. The repeater owner(s) should consider serving the needs of the amateur community and the population in general (as many repeaters are most valuable as emergency communication tools), and place his repeater in a location that would be within his range for remote control. That is, a repeater owner would be a bit off the mark to select a repeater site that would not allow him personal radio access. As I've traveled throughout the country, I've found most good repeaters to be at the same locations as the local FM radio and television station transmitters, police and fire department repeaters, paging systems and other transmitting equipment. This makes a lot of sense—those users have already determined where the good VHF/UHF radio locations are, and may have spent a lot of money doing sur-

veys to make this determination. There's no reason to reinvent the wheel and try to find a better site than others have already found, unless you live in such a rural area that no other services exist at all.

The *problem* with using these great radio sites is that there is usually someone else already using them, and that can create interference. It is not uncommon in densely-populated areas for a single hilltop to be home to dozens of transmitters and repeaters on all different frequencies, and the resultant QRM from intermodulation and radio-frequency mixing products, harmonics, spurious (undesired) signal radiation, etc., can be murder. Often, a single hilltop location may serve for several *amateur* band repeaters, including some operating on the same band! In these cases, a *lot* of system engineering is required to keep the peace and let all the repeaters perform properly. This can get pretty complicated, and sometimes requires additional cavity filters to reject unwanted signals or protect the receivers from radiation, or precise antenna placement may be used to create "pattern steering" for these purposes. Physical spacing between antennas used for nearly the same frequency often helps reduce interference, and on big, spread-out hilltops, you'll often see antenna towers located hundreds, or even thousands, of feet apart in an effort to make everything work and keep everyone happy.

Unfortunately, some mountaintop locations are so popular that their antenna population can be overwhelming! Examples of this are found in Southern California on Mt. Wilson, Oat Mountain, Saddle Peak, Santiago Peak and other popular radio locations. Similar situations exist atop the World Trade Center in New York City, the Sears Tower in Chicago, the Prudential Tower in Boston, and elsewhere. Even Pack Monadnock Mountain in Southern New Hampshire, with a relatively small local population (of people), is a crowded radio site. Believe me, it would be difficult to find that great radio location that nobody is already using! The exceptions are well-sited *private* properties, which do exist and sometimes are available for amateur repeaters if the owners are properly approached.

How high does a repeater have to be? There's no answer to that question because it all depends on the local terrain. The key to success is usually finding a site that has sufficient *height above average terrain* or HAAT to allow effective and reasonably long-range VHF/UHF communications. In Rhode Island, where the highest hill in the state is only about 800 feet above sea level, there are some terrific VHF radio locations at elevations of 400 feet above sea level and lower. Here in Southern California, the wide-area repeaters are all 2,500 feet above sea level and higher, with some residing at elevations of 10,000 feet and more. Because radio signals tend to reflect off, or be absorbed by, earth (almost regardless of the local earth's composition, which varies widely with location), repeaters are most effective when they are literally "line-of-sight" to their users. Of course, VHF signals *will* bend over the horizon and, under some conditions, can be ducted hundreds of miles, but you can't really depend on these things.

To help prevent tampering or downright theft of costly equipment, many times repeater owners will not completely identify the locations of their repeaters. This is reasonable and completely lawful. Repeater locations are *not* registered with the FCC (although they once were, back when repeater licenses were being issued—this stopped in the early 1970s), and really only need to be properly identified by longitude and latitude, and height above average terrain, to the local repeater coordinating group (usually a committee of volunteers) so they may make an intelligent decision regarding frequency allocation.

Now would be a good time to point out that while the FCC does not issue repeater licenses, and any licensed amateur Technician Class and above can own a repeater, repeaters should all be *coordinated* for the prevention of interference to other repeater owners or other services. To simply put a repeater on the air without getting its operation sanctioned in writing by the local coordinating body is a very poor idea—although you may get away with it in some unpopulated areas. In densely populated regions (all the major metropolitan areas in the U.S.) it is common for there to be no openings for a new repeater, meaning, in effect, that you will not be allowed to put a new repeater on the air on your band of choice until some repeater closes operations or relocates. If you desperately want to put up your own machine, you'll only have two choices in this case: Select a different band, where an opening exists, or operate a renegade (unsanctioned) repeater. The renegade repeater idea isn't very good, and if enough complaints are registered about your operation you may end up losing your investment when it is literally demanded by the coordinating council that you take your system off the air. Of course, a newcomer might get away with a renegade that is a low-level repeater—one that is not well-sited and not usable from too great a distance. Many unsanctioned low-level repeaters exist, and they don't bother anybody. But a low-level repeater almost defeats the purpose of having one, since its users might be able to communicate simplex.

The best radio sites frequently are owned or managed by commercial operators who will charge monthly or quarterly fees for using their property. Usually, the better the location is, the higher the fees will be. Sometimes, however, repeaters can be located on public or government-owned property for free. Or, of course, there are hilltop residence owners who might allow placing a repeater in a garage or utility building. There is a great deal to investigate regarding repeater site selection. I've known hams with wonderful, operational repeaters and no place to put them, and others who take years to find a suitable site. All the more reason to respect repeater owners for their dedication.

Repeater Operation

This is the fun part! Once you familiarize yourself with your equipment and know how to select or program offsets and PLs (also called CTCSS, for Continuous, Tone-Coded, Squelch systems), you're ready to make repeater contacts. Protocol varies around the country, but in general, the use of the word "break" to enter a conversation is *not* condoned except in an emergency. If you hear a conversation you'd like to join, wait until there's a break in the QSO (when one station stops transmitting, and before the next one starts) and transmit, announcing *only* your callsign. Don't be shy! These breaks in conversations are often only one second long, and if you wait before you press the push-to-talk button, you'll be locked out of the QSO! But avoid any extraneous conversation, and just speak your callsign, period. If you are heard, you will usually be acknowledged, and the station who acknowledges you will give you a chance to say something.

When it is turned over to you, *say something*! If you're new on the air and don't know the stations in the QSO, you might start out with something like this:

"This is KD6XYZ, and my name is Bob. Can you copy me all right? Let me know, before I go on and on to find out you're not hearing me." (This is an excellent way to start out in a new group, and proves you know what you're doing.)

Assuming they can hear you, your next transmission might be:

"Thanks for the nice report, Al. I'm new on the frequency, so bear with me, please. As I said, my name is Bob, and I'm in Culver City. I've been listening to you guys for a few minutes, and your conversation was interesting, so I thought I'd break in to ask a few questions. Is that okay?"

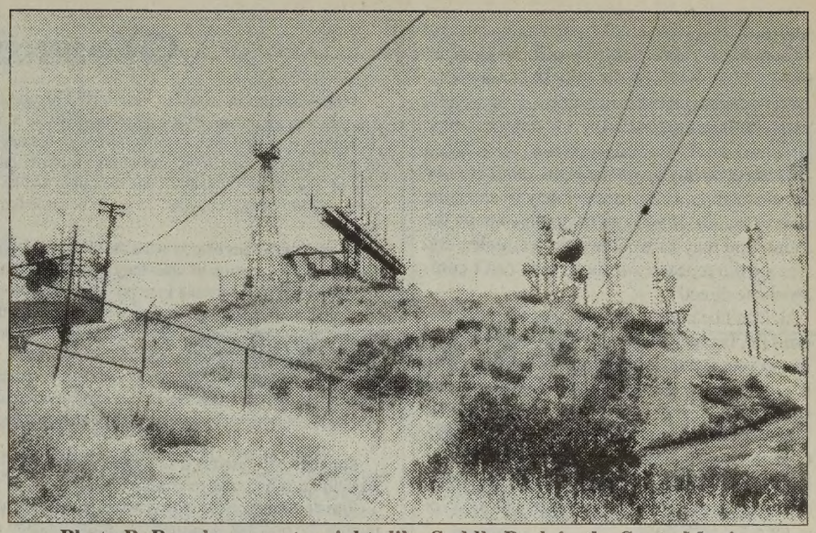

Photo B. Popular repeater sights like Saddle Peak in the Santa Monica Mountains often resemble antenna farms. This site has an elevation of 2,805 feet and overlooks Los Angeles and the Pacific. Coverage from here ranges around 15,000 square miles.

(Another great, well-thought-out transmission. You gave sufficient detail without being long-winded, and have complimented the other operators. And it was good to give your location precisely rather than in vague terms such as "Los Angeles," which could mean almost anywhere, so the other ops can comment on whether your signal is about as it should be from that area.)

Now you wait until it's your turn again. This may be only a second later, or it may be minutes. So what? There's no hurry in a casual QSO. In a bona fide emergency, you'd use a different operating technique. Okay, it's coming back to you, so here goes:

"Well, nice to meet you, too, Vicki. When I first heard you two speaking, I didn't know you were married to each other. I wonder how long you've been married? Any kids? Have you lived around here long? I'm married only six months, and we just moved here from Des Moines, Iowa, so I'm still getting used to the traffic—but no complaints about the nice weather. The rig here is a Kenwood 215 handheld, and right now I'm walking to the corner market for a carton of milk. The repeater is full-quieting here and sounds great! From home, I'm setting up to operate on the HF bands and hope to get my antenna up this weekend. Well, back to you, Al. Did you copy all okay?" (Wonderful! You're a new ham, but you're making interesting conversation, telling them about yourself and asking good questions.)

From this point on, you can see that a repeater contact isn't any different than any other kind of ham radio conversation. But *keep in mind* that many, many others may be listening and waiting for the repeater to "free up" so they can use it. They may not want to break into your QSO and are just politely waiting. So, keep each transmission reasonably short, and when you pick it up (when there's a break and it's your turn to transmit), wait a few seconds before transmitting to allow others an opportunity to break in, make a call, declare an emergency, or whatever.

If the repeater you're using has a "reset beep" or "courtesy tone" (a tone beep it transmits after each user's transmission), *wait for this beep*, and then maybe another second longer, before you start transmitting. In some cases, the beep is there just to make the users think about operating courtesy; in others the beep indicates the repeater's timer has reset, so when you start your transmission you will have sufficient time to say something without "timing out" the repeater. Timing out is no big deal unless a user with a potential emergency is waiting to use the system. Don't be embarrassed if you time out a repeater—use it as a learning experience. If you hear a beep on the repeater, it would be wise to ask, "What's the beep indicate on this machine? How long is the timer? Is it normal protocol to wait for the beep before transmitting?" These are perfectly good questions, and the other users will appreciate your asking them.

Remember that, as in any amateur communications, you must identify your station at least once every 10 minutes during a QSO, and sign off with your station callsign at the end of the QSO as well. This isn't any different than is required on simplex, or on 40 meters, or anywhere else. It can be particularly annoying to users if you ID with your callsign very frequently—it isn't necessary, and takes up repeater time. However, if you hear another user address you by an incorrect callsign, feel free to correct him.

It pays to have a repeater directory to which you can refer to find out about your local repeaters. Many are published; some are national, with listings for all 50 states and sometimes beyond our borders, while others are local, just for your area. It's fun to have both kinds and read them over. Because these directories might only be published annually, they can contain errors. No big deal—they're mostly right, and that's good enough to have fun.

Find out from some of your first repeater contacts if there's a local emergency repeater which is reserved primarily for communications of great importance. In most metropolitan areas, there's at least *one* emergency repeater per popular band (at least on 144, 222 and 440 MHz). Sometimes these emergency machines are directly linked to police or other public service agencies. They are very helpful to have around, but general chit-chat on them is usually frowned upon.

You might also try to find out if any of the local repeaters have special features like emergency power, autopatch, public service bulletins, commuter traffic reports, an open-access 911 dial-up, links to other repeaters and so forth. Linked systems are quite popular and are available in most parts of the country. The Condor system in California (on 222 MHz) is a classic example of an excellent link system that covers from the San Francisco Bay area down to Mexico, up to Las Vegas, and over to Kingman, Arizona. Although it has holes in its coverage due to the mountainous terrain around these parts, the system covers most of a 120,000-square-mile area!

Caveats, No-Nos, and Faux Pas

Even though most of our readers are already good operators, or at least intend to be, here are some things to avoid and the reasons why.

1. When working through a repeater, don't analyze someone's signal strength or modulation quality. The repeater may be pinning your receiver's S-meter, but that means absolutely noth-

ing about how strong the station you're working is—or isn't. Until he drops out of the repeater, you cannot tell if he is strong or weak, or somewhere in between. Many repeaters change audio characteristics and deviation levels, so unless you can switch your transceiver to reverse and hear the other station on the input, don't critique his modulation, as the repeater may be changing how it sounds. If you can hear someone on the input, you may as well switch to simplex and free up the repeater for those who can't communicate directly.

2. Don't be impressed when you can work stations far, far away through a well-sited repeater. It isn't your station or his doing most of the work, it's the repeater doing it. Some repeaters have such excellent sites that 200-mile QSOs on the VHF/UHF bands are very routine, even though these distances may be impossible from base to base. If you want to make a statement regarding coverage, compliment the repeater and its owner for a job well done.

3. If you're working through a repeater from a base station using a directional antenna (beam), remember to aim the antenna at the repeater, not towards the station you're trying to contact. It doesn't matter where he or she is, it's the direction to the repeater that is important.

4. If you're working mobile and trying to contact another mobile just a few car lengths away via a repeater, don't be surprised if you can't do it, even though you may both have terrific signals into the machine, and even be line-of-sight to it. The reason for this is: Your transmitter will probably desensitize his receiver, and his transmitter will desensitize yours, so you'll both sound weak even though you're both making the repeater just fine. This is a classic problem. The easy solution is to switch to simplex! (Remember, the main intent of any repeater is to allow communications between stations who otherwise couldn't hear each other. If you're using repeaters to work stations local to you, who you could easily work via simplex, you're violating the primary rule of repeater work.)

5. Don't be surprised if you hear a repeater better than it hears you, especially if you're running low power or a minimal antenna system. Many repeaters transmit with 100 watts of power into a highly efficient antenna system. Some users are operating HTs with 2, 3 or 5 watts of power into not-so-hot antennas. The power discrepancy is absolutely huge, and even if the repeater has the world's hottest receiver, it may not hear you nearly as well as you hear its high-powered transmitter. The solution, obviously, is to get closer to the repeater or to improve your transmitter or antenna. Some repeaters are real miracle workers and seem to hear a pin drop a hundred miles away, but they all can't be that good.

6. Observe local repeater protocol and follow it religiously. Don't switch on your rig and immediately make a call through a repeater, unless you're dealing with a real emergency. Stand by for a minute or two to be sure the repeater isn't already in use, in the middle of "net" traffic, or whatever. You'll be labeled a "lid" for life if you inadvertently break into some important communications.

7. Last, but certainly not least, don't follow in the footsteps of the clown crowd. Almost every wide-area repeater has its resident fools who jam, use profanity, talk over others, etc. Ignore them and be a courteous, professional operator. This will make the lasting impression that you're not one of the clowns, and you'll be welcome for life. Remember, the FCC rarely intervenes in amateur matters—although hams have received citations, had licenses suspended or revoked, and even (in one famous case) served prison sentences for unlawful operating.

Have fun and use your local repeaters for what they were intended, and you'll find them a valuable asset to your amateur operations. RF

Glossary of Repeater Terms

When you enter the world of VHF/UHF FM amateur radio, you'll encounter a whole new language. If you listen carefully to a few active repeaters prior to making your first transmission (although it's hard to resist the temptation to use a new toy), you'll pick up enough repeater jargon to chit-chat with the best of 'em. Even if you don't use the lingo, and it is by no means a requirement of FM operations, you'll want to become familiar with some of these terms.

Accessing: Means exactly what the dictionary says. Ops often use this word following a description of what they are about to do, like "WB2WIK accessing autopatch." This means I intend to use the autopatch on a repeater.

Crossband: Working two bands at once, by transmitting on one and receiving on another. This is legal on the VHF-UHF bands and is a popular sport among repeater and remote-base station operators.

Duplex: The ability to transmit and receive simultaneously. Repeaters operate in the duplex mode, but so can some modern-day rigs which duplex on two bands by receiving on one while transmitting on another simultaneously.

For ID: Often used as a suffix to a station identification, as if there could possibly be some other reason for identifying.

Functioning: Similar to *accessing*, but is usually a more passive term that implies the operator is performing some function on or to the repeater and won't necessarily get a reply from the machine as he would with an autopatch.

Machine: The repeater or remote-base equipment.

PL: This is a trademark of Motorola, and is an abbreviation for private line. It is synonymous with CTCSS, but is easier to say, so many hams call tone-activated squelch systems PL. There are 42 standard PL tone frequencies in the range of 67.0 to 254.1 Hz. The tones, which modulate the FM transmitters, using them at a very low level so they are normally not detectable by ear, are used by repeaters to help prevent co-channel (two or more repeaters on the same frequency pair) interference. It works. Because you really shouldn't hear the tone modulation (although receivers equipped with the proper electronic decoders can), these tones are called "sub-audible."

Remote: Usually an abbreviation for a *remote base*, which is similar to a repeater but may not be coordinated or have published access frequencies. Remote bases are usually crossband systems with an input on one band and an output on another, and are set up by private operators for their own convenience. Some are technically very sophisticated and have autopatch and the ability to change input/output frequencies by remote commands and control. It is impolite to intentionally use someone *else's* remote base without their permission, although you may find yourself occasionally using one without even knowing it.

Simplex: Transmission and reception on a single channel frequency, which obviously cannot be done simultaneously! Point-to-point contacts without the use of repeaters are simplex.

Tones: Used as an abbreviation for both PL tones and "touch-tones" (which is a registered trademark of AT&T). If you own a telephone, you should know what touch-tones are; they are often used to control repeater and remote base functions as well as to access autopatches for making phone calls.

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PB7	7.2v	@	1500 mah	$49.00
PB8	12v	@	800 mah	$49.00
PB-13	7.2v	@	750 mah	$37.00
PB-14	12v	@	800 mah	$49.00
PB-18	7.2v	@	1500 mah	$47.00

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FNB-25	7.2v	600 mah	$35.00
FNB-26	7.2v	1100 mah	$44.00
FNB-26S	7.2v	1500 mah	$49.00
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Nervous Habit

The Associated Press reports the mystery of an electrician's lead poisoning was solved when the man revealed he enjoyed chewing bits of plastic coating he stripped off wires. A routine blood test indicated 48-year-old Elmer Galbraith, who lives near Johnstown, Ohio, suffered 10 times the normal lead level for humans.

Galbraith knew something was wrong when he sensed a tingling in his fingers and began suffering from memory loss and diminished math skills. The unusual case was documented in a government report which issued a warning about the hazards of chewing plastics which may contain lead. *TNX A.P./Scott Schram KN4L.*

Windy City Scanners Safe

Members of the Chicago Area Radio Monitoring Association are breathing a collective sigh of relief after waging a successful battle against the Chicago Scanner Bill. Jon Peterson N9OUM contacted this publication back in July when he found out members of the Chicago Board of Aldermen had proposed passing an ordinance which would have made owning a scanner a crime.

The names and addresses of these aldermen and details of their proposal spread like wildfire to computer bulletin boards across the country—including the *73* BBS. Jon reports that the response was impressive enough to cause the Chi-town leadership to do an about-face on the issue. The revised ordinance proposal punishes only those individuals who use scanners to commit crimes or interfere with police. A pat on the back for those who wrote letters. *TNX N9OUM/The Chicago Area Radio Monitoring Association.*

WACO Hams

At least two licensed amateur radio operators are now believed to be among those killed in the Branch Davidian Compound fire near Waco, Texas, on April 19. The FBI has identified Jeffrey C. Little and Douglas W. Martin as being among the followers of cult leader David Koresh who perished after the coumpound was set ablaze.

Koresh is believed to have set fire to the compound rather than surrender to the FBI after a prolonged armed standoff. Little AB5KZ and Martin AB5LA had both upgraded to Amateur Extra Class on February 23rd of this year. *TNX Westlink Report, June 25, 1993.*

Mega-Telescope

The largest single integrated astronomical instrument in the world formally entered service on August 20, when the Very Long Baseline Array (VLBA) was dedicated at ceremonies in New Mexico. The continent-wide radio telescope system is the culmination of a half-century of development in radio astronomy.

The VLBA offers scientists the most detailed views of celestial objects available from any telescope on earth or in space. With 10 receiving stations distributed across 5,000 miles of US territory, its radio vision is sharp enough to read a newspaper in New York from the distance of Los Angeles.

To make images of astronomical objects, the VLBA uses ultra-sensitive radio receivers, super-fast tape recorders, atomic clocks accurate to within one second in a million years, and a high-performance computer that can perform 750 billion computations per second. The project is funded by the National Science Foundation. *TNX National Radio Astronomy Observatory.* RF

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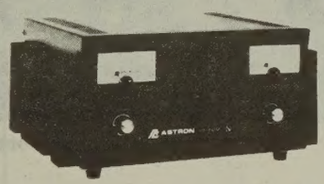

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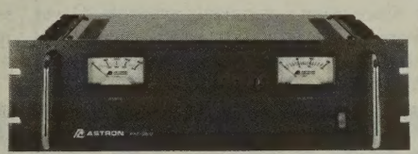
SL SERIES

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• LOW PROFILE POWER SUPPLY						
SL-11A	•	•	7	11	2¾ x 7⅝ x 9¾	11

RS-L SERIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE				
RS-4L	3	4	3½ x 6⅛ x 7¼	6
RS-5L	4	5	3½ x 6⅛ x 7¼	7



RM SERIES MODEL RM-35M

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RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

Build a Versa-Patch

A highly versatile phone patch for under $20!

by Klaus Spies WB9YBM

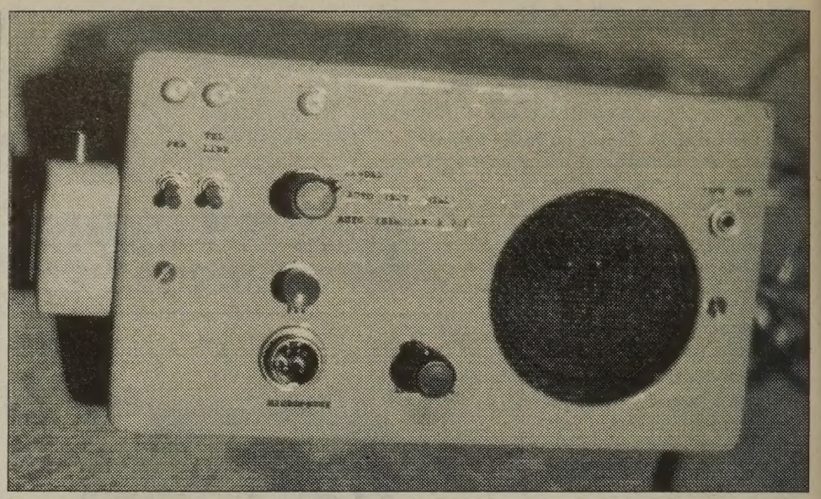

Photo A: The completed Versa-Patch.

A telephone-to-transceiver interface "patch" is a lot simpler (and cheaper) than most people realize. Here's one with as many (or as few) bells and whistles as you need. All it takes is a half hour with a soldering iron, and a little less than twenty dollars!

The five components connected across the telephone line in Figure 1 are all that it takes to keep Ma Bell happy. When S1 is closed, R1 provides a DC load to seize the line, while L1 chokes off low frequency audio (speech), so it does not get grounded. Since telephone line voltages vary in different areas of the country, it may have to be altered slightly in value to suit your lines. The value shown works well in the Chicago area. C1 blocks DC from the telephone line transformer. Typically, 10 µF is used for audio frequencies, but it's not a value that's engraved in stone; I used 4.7 µF because I found several that were nice and small in my parts bins. The only critical part here is the telephone line transformer. The telephone company sets up their lines for 600 ohm impedances, and a true telephone line transformer has the static shield shown on the schematic. Because the telephone company has some exacting standards, these transformers (new) go for $11 to $15 (I was able to scrounge a boxful that are secondhand, in almost-mint condition, and would be willing to sell them for $5 each, plus S & H).

After all this isolation, it's fairly safe to hook up almost anything we want. U1 shows the typical amplifier I used, for a variety of options. Operational amplifiers show a very light load to the circuit, as well as good gain characteristics in the audio band. These characteristics provide a lot of flexibility for expansion of our circuit.

For the beginning experimenter or for someone needing only a simple telephone patch, Figure 1 shows everything you'll need. Adding more amplifiers in the configuration of U1, though, adds several options for the more adventurous builder. In addition to using an amplifier of this configuration to feed audio into your transceiver, another amplifier can feed a tape recorder for logging; yet another an amplifier for a speaker.

Timeout Control Circuit

The only additional requirement for a true autopatch (for automatic operation) is some way of making a transceiver toggle on and off transmit mode. If you're helping a DX station patch into your local telephone line, a simple momentary switch wired to the radio's PTT line is sufficient. For other operations, control circuitry becomes very useful.

In helping out on a local net, I used my own patch (instead of the repeater's) to air reports for the net. I could either do it manually, while holding a stopwatch (so I don't timeout the repeater), or I could take the easy way out and build a circuit to do that for me. I decided on the latter.

The local repeater required only a brief letup on a carrier to reset its timeout timer, and had a three-minute timeout. I decided to play it safe, and have my circuit unkey after two minutes. I thought 0.3 seconds was plenty of time to let the repeater reset while not having too much of the report cut out. This led to the development of the circuit shown in Figure 2A.

Since using a commonly available IC was more important than any super-accurate timing function, I chose to work with the 555 timer IC. To get the 120-second-to-0.3-second timing ratio, I could either sit for hours to calculate the proper values for R1 and R2, followed by spending extra money on 1% tolerance resistors; or I could wire the 555 to run at a convenient speed and let a divider do all the work (and save money on precision resistors).

In case you're planning to use this circuit in a similar fashion, be sure to get the timeout as well as reset times from your local repeater club. For your convenience, the formula required to recalculate the speed of the 555 is given with each diagram. One point to note with the 555 is that the values of R1 and R2 affect the duty cycle *and* the speed (frequency) of operation. If the waveform becomes too asymetrical, the clock pulse may look more like a short transient spike and the 4040 will not switch properly.

Since the 4040 counter is capable of much higher counts than required of this circuit, a reset is needed. U4B is connected to provide a reset.

For a simplex autopatch, Figure 2B can be used. The windows during which a transceiver will listen for a signal are slightly longer, and the spaces between windows considerably shorter. This way, if you feel the party at the other end may say something inappropriate

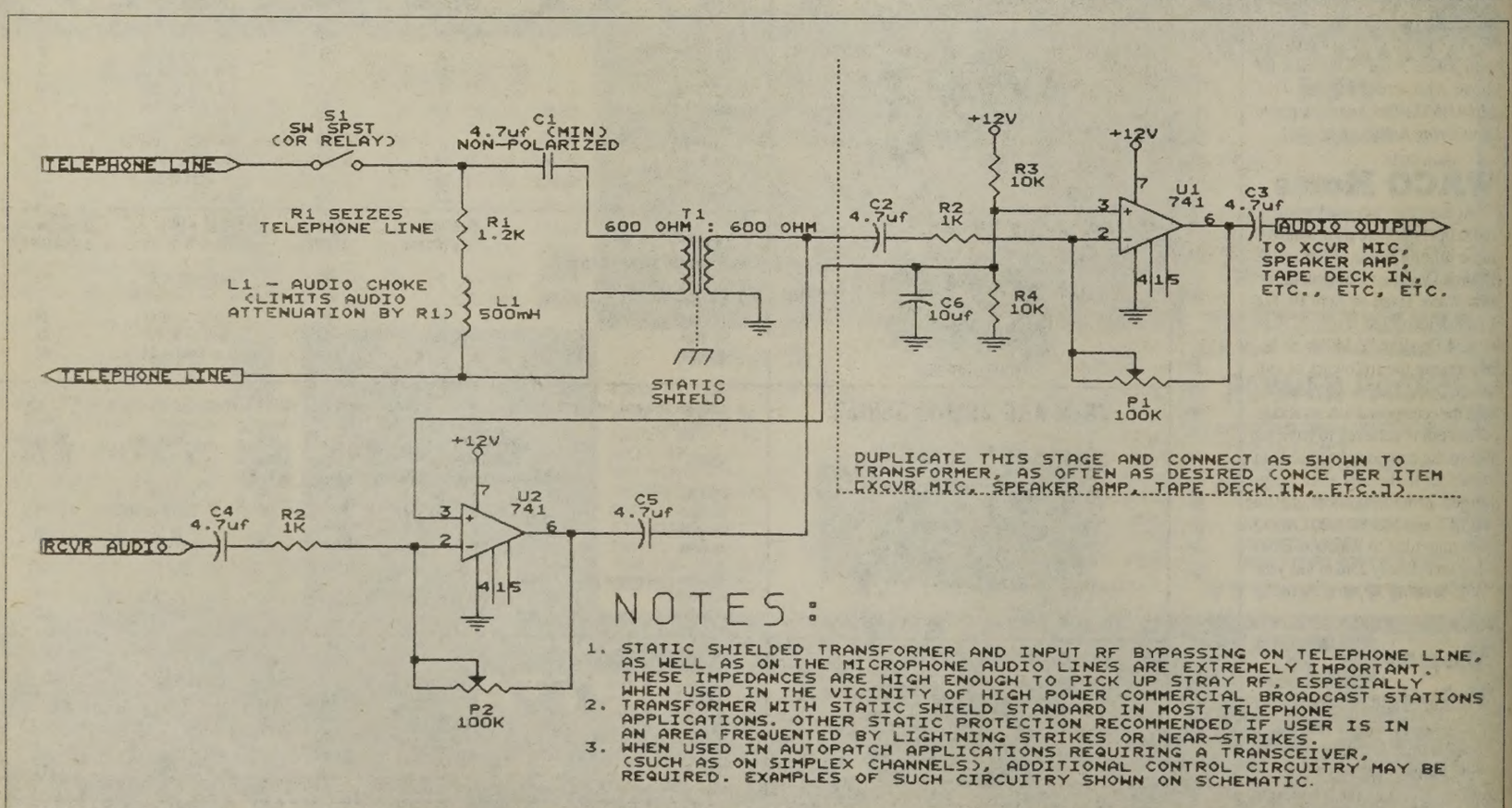

Figure 1. The basic telephone patch circuit.

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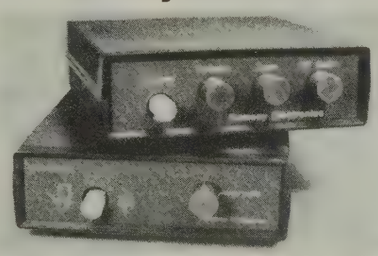

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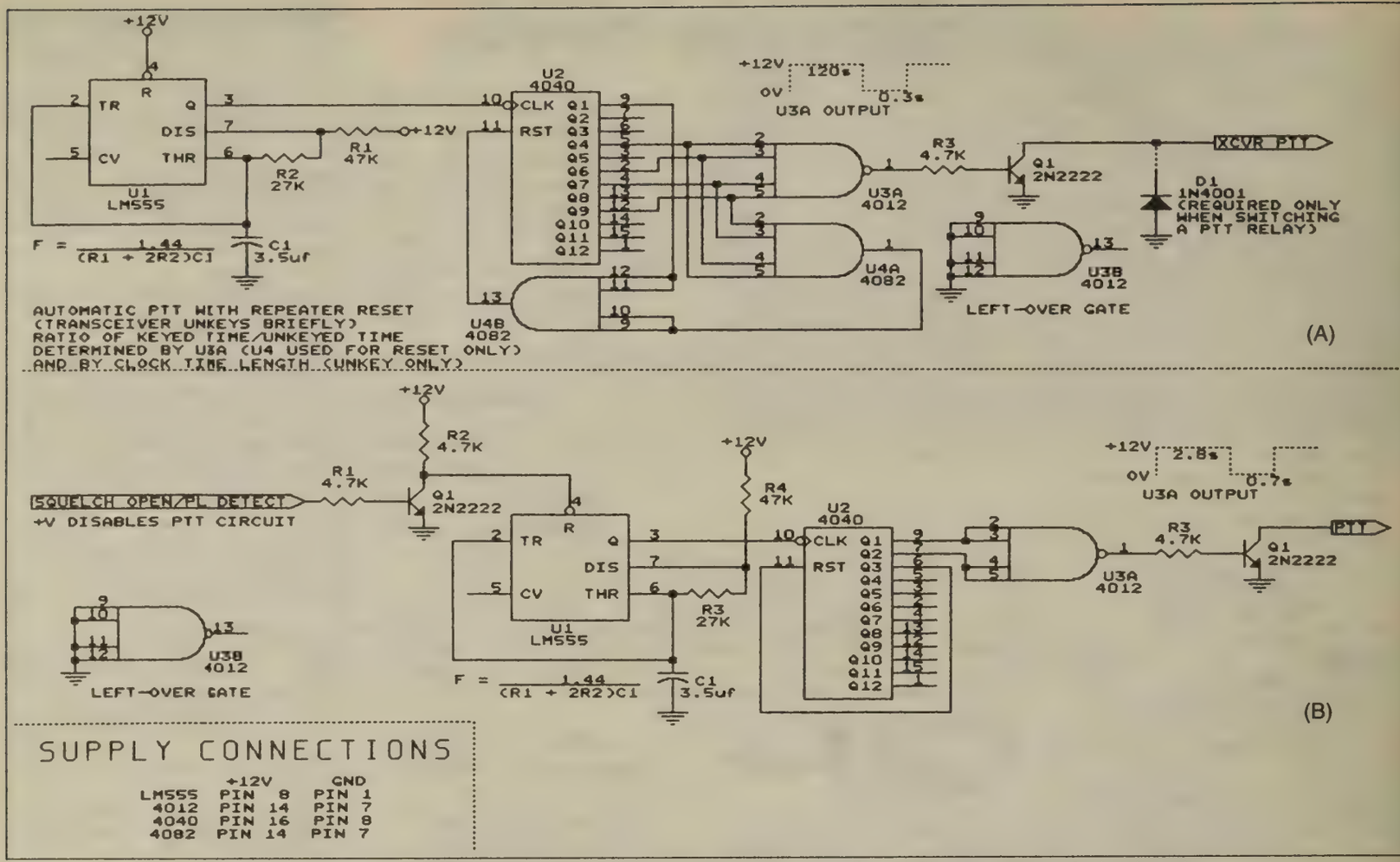

Figure 2. A) Automatic PTT with repeater reset (transmitter unkeys briefly). B) Simplex autopatch circuit option.

for air, you can key up (from your HT or mobile) and keep your simplex patch at home in receive mode.

This circuit will keep the transceiver in receive mode for the duration of the window (0.7 seconds shown), or when disabled from the receiver's squelch. This can either be done directly from the squelch, or with a PL decoder. Since a receiver's squelch opens briefly when a transceiver toggles from transmit to receive, it is recommended that a PL be used to avoid any false signals.

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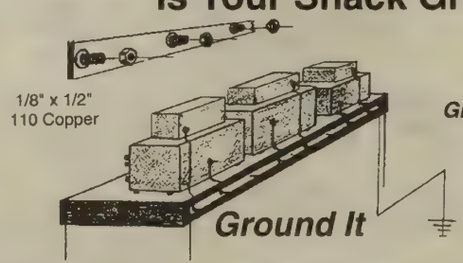

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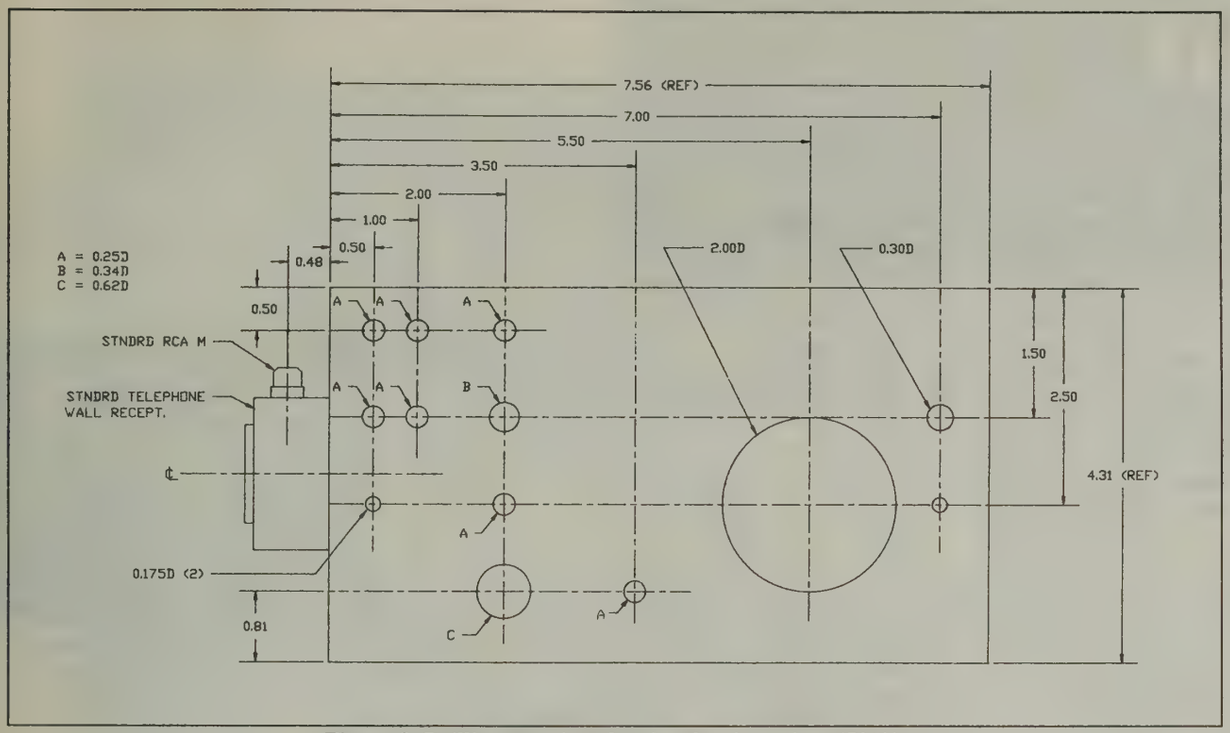

Figure 3. Drilling template for the aluminum box (50%).

The patch prototype I built (and used on a local net) has a three-position rotary switch to select the desired method of PTT: manual, auto-net control (see Figure 2A), or auto-simplex A.P., with the manual PTT switch mounted underneath it. Below that, I have a microphone plug that, when the microphone is keyed, bypasses the patch entirely for priority announcements, identification, etc. (see Photo A).

Assembly

I've found that both microphones labeled "low impedance" and typical telephone lines are of a high enough impedance to pick up stray RF. In my case, it's a local AM broadcaster so it cannot be emphasized enough to use proper shielding and bypassing on all incoming and outgoing leads. I installed my entire circuit in a deep-drawn aluminum box, and put RF chokes, bypasses, and ferrite beads on all input and output leads.

For power and the telephone line, I bought a standard cube-style wall phone jack outlet. This allows quick connect and disconnect from the phone line. This style connector box has enough room for mounting an RCA jack on its side for power. This style connector is quite capable of handling the low power levels required by the patch, and has the extra safety feature of being foolproof (there's no chance to accidentally reverse polarity and zap all the ICs!). The only wires exiting the box are for the microphone and the "EXT SPKR" jack for the transceiver. RF

Parts Sources

1. Digi-Key Electronics: (800) 344-4549.
2. Tri-State Electronics: (708) 255-0600.
3. Telephone line transformers: Klaus Spies WB9YBM, 8502 N. Oketo Ave., Niles IL 60714-2006.

letters

Continued from page 5

adopted the generally accepted definition of QRP as 5 watts output CW and 10 watts PEP SSB.

"The voluntary 100 watt power limit was later abolished; members may run any legal amount of power necessary at any time, for any purpose, although the 5 watt limit should be observed when claiming to be operating QRP. Club awards and activities are geared to the 5 watt and under level. The QRP ARCI does not advocate the reduction of the legal power limits of amateurs in any country, and serves only to provide a forum for those who enjoy the thrills and challenges of building and operating with low power equipment."

Anyone interested in information on the QRP ARCI should send an SASE for a copy of our brochure, or $2 for a sample copy of the *QRP Quarterly,* to our Publicity Officer, Michael Bryce WB8VGE, 225 Mayflower NW, Massillon OH 44646. (Mike is a writer and columnist for *Radio Fun*, as well as the QRP columnist for *73 Amateur Radio Today.)*

"Confessions" also mentioned an "old British-based QRP society." I know nothing of that, but the GQRP Club was founded in 1974 by Rev. George Dobbs G3RJV and, at about 4,500 active members, it is probably the largest QRP organization in the world. They also go by the 5 watt power limit, although until just a few years ago they used 5 watts input instead of 5 watts output. While physically smaller than the *QRP Quarterly*, their journal, *SPRAT*, is quite popular both over there and in this country. They even have a point of contact in this country, which makes it very easy to join up: Luke Dodds W5HKA, 2852 Oak Forest, Grapevine TX 76051.

Happily, W4WFL is far from the only "low power freak"; QRP continues to have thousands of followers around the world. RF

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RF kit review

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Ramsey SA-7 Broadband RF Amplifier

by David K. Pelaez AH2AR/8

Top view of the assembled Ramsey SA-7 Broadband RF amplifier.

The SA-7, new from Ramsey Electronics, is an easy-to-build kit for a general purpose broadband RF amplifier, capable of operating from 100 kHz to 1 GHz. It's small on price but big on performance.

After searching high and low (no pun intended) for an inexpensive preamp to help boost the front end of a tired shortwave communications receiver, I came across a Ramsey Electronics advertisement announcing several new "mini-kits." The SA-7 preamp kit was inexpensive, so I took the plunge and ordered it. One week and $15 later, I received a curiously small parcel from Ramsey.

Assembly

The SA-7 is easy to assemble. There are only 15 components to mount on a phenolic circuit board measuring 1-1/4" x 1-5/8". I put it together in about 15 minutes using just a soldering iron, a steady hand, and about an inch of solder. You won't need to use any tuning or test equipment after completion. Even a first-time kit builder can tackle this project with confidence.

But, even as a "veteran" kit builder, I almost forgot to install the kit's only SMT (surface mount technology) resistor. After assembling and soldering all the components on the PC board, you must solder the SMT resistor between the two designated foil traces on the foil side of the board. Remember also to keep all of the other component leads as short as possible if you want to exploit the amplifier's capabilities on the "high end" of its range. Long component leads may also cause it to break into oscillation.

Amplifier Application

After mounting the SA-7 within an Allied AX-190 receiver, I put in a jumper within the receiver's power supply and borrowed approximately 9 volts to run the newly installed amp. Current drain is minimal (less than 50 mA) and the power requirement for this amp is 8 to 15 volts DC. Since this voltage is available in most solid-state equipment, it's a snap to use the available power already present within the gear. The extra current drain usually won't be noticed. If you opt to use the SA-7 in a tube rig, a 9 volt battery or an outboard power supply would be an alternative solution.

After turning on the receiver with the SA-7 in line, I was pleasantly surprised to notice a marked increase in the number of stations on the air. I noted a solid 2 S-unit jump in signal strength throughout the HF receiver's range. Stations barely audible with the SA-7 out of line came up to "armchair copy" when the amp was put between the antenna and the receiver. I noted an increase in the noise floor, but the 2-plus S-unit increase in received stations' signal strength more than compensated for the associated and expected increase in the receiver's noise floor. The spec sheet indicated a 3 to 5 dB noise figure.

Technical Information

When preamplifiers are added to a receiver, images and heterodynes may appear, especially if the preamps don't have selective filtering as part of their design. At VHF and UHF frequencies, images can become a real problem when the receiver and antenna are located near crowded RF environments. Some preamps may end up acting like broadband mixers. I didn't notice this with the SA-7, but it could become a problem.

The design of the SA-7 is simple and straightforward, and the addition of helical filters or tuned circuits would totally defeat the idea of keeping this kit under the $15 mark. This amplifier contains two stages (with no tuned elements): a common emitter stage which drives an emitter follower by utilizing two 2SC 2570s. Page 17 of the ARRL publication *Hints and Kinks for the Radio Amateur*, circa 1975, described a similar circuit design as a "general purpose preamp." This publication stated that a common emitter-follower stage tends to be unstable but, as explained in the *Handbook*, the absence of tuned elements allows for extremely good stability.

Listed specifications claim a gain of 15 dB at 1 to 950 MHz and 8 dB at 1300 MHz. The SA-7 can be used in many applications requiring extra gain in a wide variety of amateur and general coverage receivers. It can also be used to increase the sensitivity of frequency counters. Because of its small size, the SA-7 can be used internally in almost all receivers, or placed in a small chassis, for a variety of applications within the hamshack.

A Good Deal

On a scale of 1 to 10 (*not in dB*), I would give this little broadband RF amp a 10!! Now, I wonder if the SA-7 would work in boosting the horsepower in my Ford Ranger? RF

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Lightning Strikes!

A bolt from the blue—don't let it hit you.

by Charles Warrington WA1RZW

Imagine you're walking across an open expanse of freshly mowed grass when suddenly your hair stands on end and you begin to feel a tingling sensation. Think about how this feels, because it will be the last thing you ever feel on this earth. Lightning is about to strike you! Don't worry, it will be over in less than 1/10 of a second. A sudden electrical discharge of 30 million volts at 100,000 amperes will make the electric chair look cushy in comparison.

Shocking, isn't it? Well, perhaps you should have realized the danger of finishing that round of golf! Wearing cleated golf shoes and holding a metal golf club on an open fairway when lightning is present is a personal invitation for disaster!

Now, you're probably thinking: What does this have to do with ham radio? In a word, *PLENTY.*

Lightning kills an estimated average of 150 people every year in the United States alone. Many more are injured. Hundreds of animals are killed as well, and annual property damage estimates in this country run in the tens of millions of dollars. With their affection for antennas, towers, and the great outdoors, ham radio operators and their equipment can sometimes make prime targets.

Bill Axson W4SEC was sleeping in his Citra, Florida, home one night a couple of years ago while a thunderstorm crackled outside his window. "I'm very happy I was not in the hamshack at the time," says Axson. Although he did not realize it right away, all of his ham gear was wiped out instantly by a single strike to his 30-foot tower.

"I didn't know the extent of the damage until the next day. I went to fire up the station, but nothing came on." Axson says the only apparent physical evidence was a burnt telephone wire and a disintegrated telephone wall socket.

His Collins KWS-1 tube transmitter, Drake R4B receiver, and his entire 2m packet station, including an IBM clone computer, were internally fried. "Now they are about worthless," says Axson. Even the computer's hard disk was wiped out. The insurance did not cover much of the cost of the damage, estimated in the several thousand dollar range. As Axson puts it, "You can't put a price on nostalgia, either."

In 1984, Johnny Autery took what many believe is the finest photograph ever of a lightning strike. (See cover photo.) The 65-foot-tall sycamore tree in the picture is still standing today, despite its suffering a direct hit. But, that little upward stroke from the television antenna blew out the family's TV set.

It is not uncommon for trees to survive lightning strikes, although they are often left weakened. This is because the current tends to travel around the outside of the tree to the ground. If you were standing under this tree when lightning struck you would probably have fared worse, because your body offers a short circuit to ground.

What is Lightning?

Lightning has fascinated mankind throughout the ages. We all learned in grade school that Benjamin Franklin conducted his famous kite-flying experiment in 1746 to prove that lightning was made of electricity. This led to his invention of the lightning rod, which offers some protection to buildings by diverting lightning strikes through wire conductors to ground. These systems are still in use today.

Scientists in 1993 continue to be fascinated by lightning, and they are still working to unlock the mysteries of nature's incredible electric light show. Widely regarded as one of the world's leading experts on lightning, Dr. Martin Uman, a professor at the University of Florida, has written several books on the subject. (See the review of his book on page 18.) Uman says that at any one moment, there are roughly 2,000 simultaneous thunderstorms in progress around the world. Each storm typically causes one to three cloud-to-ground flashes each minute. Therefore, during any one particular second, there are 30 to 100 lightning flashes to ground occuring across the earth!

The phenomenon is perhaps best explained by analogy: You shuffle your feet across the carpet on a dry winter's day and reach for the doorknob. Your body is charged with electrons from the friction of your soles against the nylon rug. As soon as your hand gets close to the doorknob, a spark completes the circuit, sending the charge to ground. The same thing happens with clouds.

Lightning occurs when unlike electrical charges build up within cloud formations or between clouds and the ground. The earth normally has a negative charge or a surplus of electrons. Friction within clouds from rising ice particles and falling hail tends to leave the ice positively charged at the cloud top and the hail negatively charged at the cloud bottom. This leaves positive and negative charge layers. When the electrical pressure becomes strong

Continued on page 18

Photo A. Perhaps the safest place to witness a lightning storm is at Boston's Museum of Science. This 37-foot-tall Van de Graff generator creates artificial lightning bolts up to 20 feet in length at 1.5 million volts. Note that due to electricity's "skin effect," a human being can sit safely in this giant metal bird cage and observe the electricity traveling *over* instead of *through* the enclosure.

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Lightning Strikes!

A bolt from the blue—don't let it hit you.

by Charles Warrington WA1RZW

Imagine you're walking across an open expanse of freshly mowed grass when suddenly your hair stands on end and you begin to feel a tingling sensation. Think about how this feels, because it will be the last thing you ever feel on this earth. Lightning is about to strike you! Don't worry, it will be over in less than 1/10 of a second. A sudden electrical discharge of 30 million volts at 100,000 amperes will make the electric chair look cushy in comparison.

Shocking, isn't it? Well, perhaps you should have realized the danger of finishing that round of golf! Wearing cleated golf shoes and holding a metal golf club on an open fairway when lightning is present is a personal invitation for disaster!

Now, you're probably thinking: What does this have to do with ham radio? In a word, *PLENTY.*

Lightning kills an estimated average of 150 people every year in the United States alone. Many more are injured. Hundreds of animals are killed as well, and annual property damage estimates in this country run in the tens of millions of dollars. With their affection for antennas, towers, and the great outdoors, ham radio operators and their equipment can sometimes make prime targets.

Bill Axson W4SEC was sleeping in his Citra, Florida, home one night a couple of years ago while a thunderstorm crackled outside his window. "I'm very happy I was not in the hamshack at the time," says Axson. Although he did not realize it right away, all of his ham gear was wiped out instantly by a single strike to his 30-foot tower.

"I didn't know the extent of the damage until the next day. I went to fire up the station, but nothing came on." Axson says the only apparent physical evidence was a burnt telephone wire and a disintegrated telephone wall socket.

His Collins KWS-1 tube transmitter, Drake R4B receiver, and his entire 2m packet station, including an IBM clone computer, were internally fried. "Now they are about worthless," says Axson. Even the computer's hard disk was wiped out. The insurance did not cover much of the cost of the damage, estimated in the several thousand dollar range. As Axson puts it, "You can't put a price on nostalgia, either."

In 1984, Johnny Autery took what many believe is the finest photograph ever of a lightning strike. (See cover photo.) The 65-foot-tall sycamore tree in the picture is still standing today, despite its suffering a direct hit. But, that little upward stroke from the television antenna blew out the family's TV set.

It is not uncommon for trees to survive lightning strikes, although they are often left weakened. This is because the current tends to travel around the outside of the tree to the ground. If you were standing under this tree when lightning struck you would probably have fared worse, because your body offers a short circuit to ground.

What is Lightning?

Lightning has fascinated mankind throughout the ages. We all learned in grade school that Benjamin Franklin conducted his famous kite-flying experiment in 1746 to prove that lightning was made of electricity. This led to his invention of the lightning rod, which offers some protection to buildings by diverting lightning strikes through wire conductors to ground. These systems are still in use today.

Scientists in 1993 continue to be fascinated by lightning, and they are still working to unlock the mysteries of nature's incredible electric light show. Widely regarded as one of the world's leading experts on lightning, Dr. Martin Uman, a professor at the University of Florida, has written several books on the subject. (See the review of his book on page 18.) Uman says that at any one moment, there are roughly 2,000 simultaneous thunderstorms in progress around the world. Each storm typically causes one to three cloud-to-ground flashes each minute. Therefore, during any one particular second, there are 30 to 100 lightning flashes to ground occuring across the earth!

The phenomenon is perhaps best explained by analogy: You shuffle your feet across the carpet on a dry winter's day and reach for the doorknob. Your body is charged with electrons from the friction of your soles against the nylon rug. As soon as your hand gets close to the doorknob, a spark completes the circuit, sending the charge to ground. The same thing happens with clouds.

Lightning occurs when unlike electrical charges build up within cloud formations or between clouds and the ground. The earth normally has a negative charge or a surplus of electrons. Friction within clouds from rising ice particles and falling hail tends to leave the ice positively charged at the cloud top and the hail negatively charged at the cloud bottom. This leaves positive and negative charge layers. When the electrical pressure becomes strong

Continued on page 18

Photo A. Perhaps the safest place to witness a lightning storm is at Boston's Museum of Science. This 37-foot-tall Van de Graff generator creates artificial lightning bolts up to 20 feet in length at 1.5 million volts. Note that due to electricity's "skin effect," a human being can sit safely in this giant metal bird cage and observe the electricity traveling *over* instead of *through* the enclosure.

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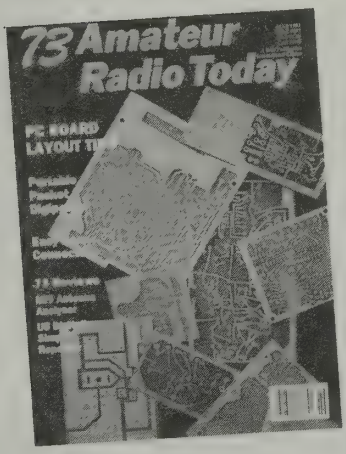

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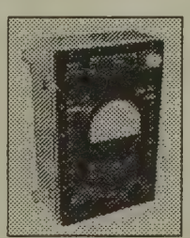

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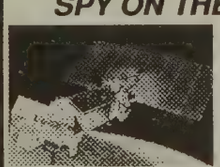

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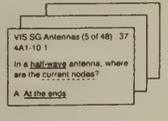

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Lightning Strikes!

Continued from page 16

enough, a flash is created between clouds or from clouds to the ground.

The peak temperature of these lightning flashes is greater than 50,000° F. That is several times hotter than the surface of the sun! This tremendous amount of short-lived heat is what causes the pressure changes, which in turn create thunder.

Types of Lightning

Lightning can be seen in a number of different formations. The typical zigzag pattern that reaches from the cloud to the ground is known as streak lightning. When the streak divides into branches, those are called fork lightning. Ribbon lightning is caused by the wind separating strokes in the overall discharge. It looks as if identical streaks are simultaneously appearing side by side. Heat lightning simply appears as bright flashes. This occurs when the lightning is too far away to be seen or heard. When this happens within clouds it is known as sheet lightning. The weirdest variation is called ball lightning. A small globe of red or white light floats horizontally close to the ground for a number of seconds before exploding. This phenomenon is not completely understood.

What Should I Do?

Even though you can't control lightning, there are some measures you can take to improve your odds. According to Uman, lightning deaths are most likely to occur outdoors. You should avoid making a lightning rod of yourself and you should not stand beneath a lightning rod, two key mistakes illustrated in our earlier golfing accident. You should avoid projecting above the surrounding landscape, as you would in an open field or on the open water. Avoid standing under isolated trees or isolated shelters. Stay away from things metallic (golf clubs, antennas, towers, pipes, and fences).

A car (not a convertable) with the windows rolled up offers decent protection. So do the interiors of large buildings, especially metal-framed ones. Properly installed lightning protection systems can save a lot of property damage. It is not a good idea to talk on the phone or use electrical equipment such as ham radio gear during a thunderstorm. Sometimes when lightning strikes a house (without a lightning rod system) the current will try to follow any metal path to ground. Electrical wiring, antenna systems, telephone wires, and water pipes are all susceptible. (These should all meet local codes.) If these conductors are not well grounded, the lightning will often jump through the air to find a path to ground. These side flashes cause a significant number of lightning deaths.

It makes good sense to keep away from any metal objects with a connection to the outdoors. The bathroom is not the best place to be in a thunderstorm! Properly installed lightning rod systems will divert the lightning straight to ground. Utilities try to accomplish the same thing by designing their systems with an easy path to ground, should lightning strike. Ham operators should properly ground their antennas and towers and use lightning protector devices. Although it may be impractical, it would be safest to unplug everything in the house at the first sign of a storm.

Today Bill Axson is back on the air using new equipment, and he has taken some precautions. All wires from his antennas are now routed through the center of the tower straight to the ground. He has installed a ground plate on the side of the tower, about 2 feet up, with two panel mount SO-239 connectors attached. From there, thick braided copper wires travel straight to three 10-foot-deep ground rods. The telephone wiring is grounded now, too. And Axson says he disconnects it when it's not in use.

Even though it packs incredible amounts of energy, lightning is usually gone in a flash. If you take reasonable precautions, your chances of injury or death are pretty small. Still, as Bill Axson says, "Lightning does strange things very quickly. Once you've seen it for yourself you realize just how powerful lightning is." RF

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Lightning Safety Rules

These safety rules will help you save your life when lightning threatens:

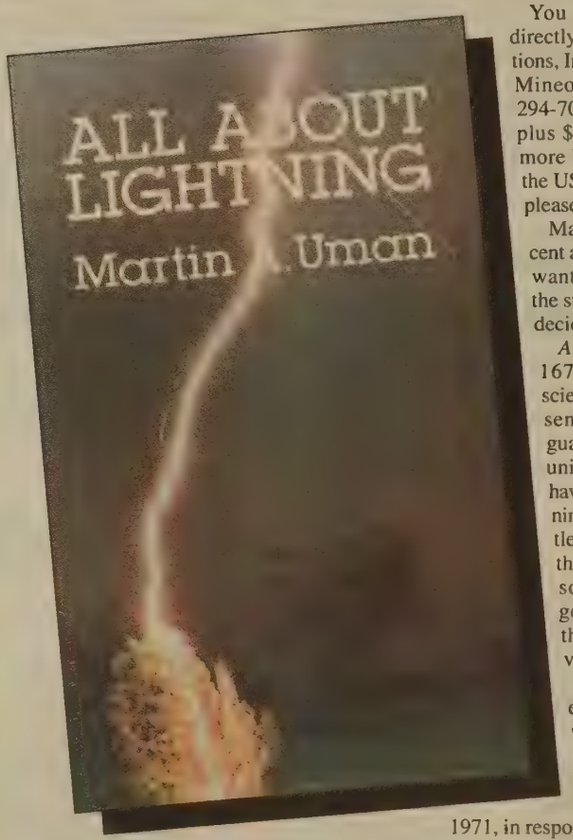
1. **Stay indoors**, and don't venture outside, unless absolutely necessary.
2. **Stay away** from open doors and windows, fireplaces, radiators, stoves, metal pipes, sinks, and plug-in electrical appliances.
3. **Don't use** plug-in electrical equipment like hair dryers, electric toothbrushes, or electric razors during the storm.
4. **Don't use** the telephone during the storm—lightning may strike telephone lines outside.
5. **Don't take laundry** off the clothesline.
6. **Don't work on fences**, telephone or power lines, pipelines, or structural steel fabrication.
7. **Don't use** metal objects like fishing rods and golf clubs. Golfers wearing cleated shoes are particularly good lightning rods.
8. **Don't handle** flammable materials in open containers.
9. **Stop tractor work**, especially when the tractor is pulling metal equipment, and dismount. Tractors and other implements in metallic contact with the ground are often struck by lightning.
10. **Get out of the water** and off small boats.
11. **Stay in your automobile** if you are traveling. Automobiles offer excellent lightning protection.
12. **Seek shelter in buildings**. If no buildings are available, your best protection is a cave, ditch, canyon, or under head-high clumps of trees in open forest glades.
13. **When there is no shelter**, avoid the highest object in the area. If only isolated trees are nearby, your best protection is to crouch in the open, keeping twice as far away from isolated trees as the trees are high.
14. **Avoid hilltops**, open spaces, wire fences, metal clothes lines, exposed sheds, and any electrically conductive elevated objects.
15. **When you feel the electrical charge**—if your hair stands on end or your skin tingles—lightning may be about to strike you. (Drop to your knees, lean forward and crouch with your hands on your knees.)

Reprinted from: The HALO—*Six Meter Club of Chicago newsletter, July 1993.*

book review

All About Lightning

by Martin A. Uman. 1986, Dover Publications, Inc.



You can order this book directly from Dover Publications, Inc., 31 East 2nd Street, Mineola, NY 11501; (516) 294-7000. The price is $5.95 plus $3.00 S&H for one or more books shipped within the US. (New York residents please add sales tax.)

Many who read the adjacent article on lightning will want to know more about the subject. That is why we decided to add this review.

All About Lightning is 167 pages of delightful scientific information presented in layman's language. Despite the nearly universal interest people have in the subject of lightning, there is precious little written on the subject that is both scientifically sound and easily digestible. That's where this paperback fills the void.

Dr. Uman is considered to be among the world's leading experts on lightning research. The first version of this book was published in 1971, in response to the questions he was most often asked by non-scientist lecture audience members. The book is arranged in chapters comprised of related groups of these questions and answers.

The book starts with a discussion of the early history of lightning research, including a look at Ben Franklin's work. Next is an explanation of lightning rods and how they operate. Chapters 3 and 4 deal with safety issues: fatality statistics, dos and don'ts, and the like. There are some interesting photos here of airplanes which were hit by lightning.

If you like the woods, and have often wondered about how trees are affected by lightning strikes, you'll find the answers here complete with photos. If you think lightning never strikes the same place twice, you ought to think again. This little paperback debunks quite a few myths.

In later chapters, Uman details the elements of weather which lead to thunderstorm formation. You will also learn the best techniques for photographing lightning strikes.

My personal favorite is the discussion of ball lightning in Chapter 15. *Boules de feu*, as they say in French, are among the most bizzare phenomena of nature. There are a good number of personal accounts of ball lightning and St. Elmo's fire (corona discharge) occurances from around the world. It's only a matter of time before Hollywood's high-tech movie-makers find a way to scare us to death with this stuff (probably in 3-D).

Anyone can enjoy reading this book. The language is plain English. Photographs and illustrations enhance understanding. This is not a textbook for electrical engineers; it is a fascinating look at one of nature's mysteries. You can obtain a good understanding of how lightning works by reading it. It's a fine book to curl up with on a dark and stormy night.

—reviewed by Charles Warrington WA1RZW

the tech side

by Michael Jay Geier KB1UM

Transmit Power

You don't need a license to listen to ham radio. You got your license for one big reason: to transmit! In fact, when you get right down to it, just about everything you learned for your exam had something to do with transmitting, right?

The reason should be pretty clear: You don't bother anyone else when you listen, but you sure can when you talk. Issues ranging from operating frequency to antenna SWR affect whether you'll bother neighbors' TV sets or other hams, or even other radio services.

One of the key aspects of your transmitting station is how much radio frequency power you pump out into the atmosphere. The FCC rules state that we should use the minimum power necessary to maintain communications. While many hams really don't adhere to that rule, we should try. Of course, it isn't always possible to know how much output we need, and we don't always have the capability of controlling our transmitter's output.

This month, let's take a look at RF power output, and examine when we need more, when we need less, and how to get the most out of what we have.

Getting There

The more power you put out, the farther you can go, right? Well, sort of, but not always. It depends a great deal on what mode (FM, SSB, CW, etc.) you are using and what it is you're trying to get across. Also, it depends on your antenna, the frequency band involved, and how that band propagates through space.

If you're like most newcomers, you've spent most or all of your time so far on VHF or UHF, probably using FM. FM represents a special case, due to the way it is received. FM receivers use a circuit called a "limiter" which amplifies whatever comes in and then clips it on both ends. The idea is to remove noise and other amplitude (signal strength) information, because the strength of an FM signal has nothing to do with the modulation on it. Remember, with FM, only the wiggling of the carrier's frequency carries any intelligence, so you can get rid of everything else. In fact, that's why it is such a relatively noise-free mode; noise is very different from a wiggling frequency.

So, how much power do you need to get heard on FM? Well, obviously, if you have none at all, no one will hear you. And, if you have lots, you'll be heard fine. So, there must be some point in between where it goes from good to bad. There is, and that point is called the "threshold." Unlike on AM or SSB, you don't get softer as your signal gets weaker. In fact, nothing at all happens until your signal gets weak enough that it starts to appear to the receiver to be nearly as weak as the receiver's own internal noise. At that point, your signal will sound scratchy and hard to understand. It's important to understand that the threshold effect is not linear—you don't get twice as scratchy when your signal goes down by half. Until you get near the threshold, you sound exactly the same. Then, you suddenly get scratchy and, if you get any weaker, you drop out altogether. This effect is the reason FMers rate signal strength in terms of "quieting," rather than strength. From the sound alone, there's really no way to know how strong you are, as long as you're well above the threshold, but you must be weak if you're scratchy. So, the best report you can get is that you're "dead full quieting," meaning you're well above the receiver's threshold.

The result is that you really don't need much power on FM most of the time. If the local repeater hears you fine on 2 watts, it will hear you *exactly* the same on 20 watts; no one will be able to tell when you increase the power! By the way, if you're in a situation where you are scratchy into the repeater and have no way to improve your signal, try talking *softer*, not louder, into your mike. The less you deviate your transmitter's frequency, the less noise and scratch will occur, because more of the transmitted energy is exactly on the receiver's frequency. That's also why a weak FM stereo signal sounds worse as the music gets louder.

Dumb Computers

If you're trying to transmit packet data, you need a pretty good signal because machines aren't as smart as we are and can't fill in missing bits of information like we can. So, if bits start getting lost, they stay lost most of the time. When receiving packet data, your station is aware of the errors and will request a resend from the transmitting station. On a noisy path, though, what you wind up with is lots and lots of resends and plenty of frustration as you wait for the data to get through.

Making It Better

There are two ways to increase your transmitting distance. First, you can improve your antenna. Second, you can run more power. Improving your antenna is always preferable because it also helps your reception, but it isn't always possible. Sometimes you already have a good antenna, or perhaps you just don't have the room for a bigger one. So, you go for more power.

"Linear" Amplifiers

If you ever played with CB (and many of us did at one time or another before we discovered the joys of ham radio), you know that "linear" was a dirty word, referring to an illegal amplifier hidden under the car's front seat. You could always tell when somebody was using one because his or her signal got really ugly and distorted. Well, here on the ham bands linear is a perfectly respectable term. We're allowed to use amplifiers, and we're supposed to know how to use them properly. Used correctly, an amplifier doesn't have to cause TV interference or other problems, and it doesn't have to sound any different from the quality of a "barefoot" station.

On FM, an amplifier doesn't actually have to be linear! By linear, we mean that its output increases exactly in proportion to its input. That's extremely important for modes like SSB and AM, where the increases and decreases in instantaneous signal strength represent the modulaton you're transmitting. But remember, as we just discussed above, on FM such changes in strength are meaningless and, in fact, shouldn't even be there in the first place! So, it is possible, and actually beneficial, to use a *nonlinear* amplifier on FM, and then use a filter to clean the signal up before sending it out to the antenna. By the way, it is beneficial not because it sounds any different, but because amplifiers can run more efficiently, and cooler, when they aren't forced to be linear. Such nonlinear amps are called "class C," and most outboard FM-only amps are of that type.

Uh-Oh

The problems come when you try to use a nonlinear amplifier on a mode which demands linearity. That's what happens with the CBers, who are, of course, running either AM or SSB. They take a linear amplifier and overdrive it to the point where it just can't give any more. Now that poor amplifier becomes nonlinear, with the result that parts of the RF waveform get clipped off, causing terrible distortion and splatter, not to mention TV interference and extremely annoyed neighbors. The bad operators think they are going to be better heard as they turn the level up higher and higher, but the opposite is true. Once you get past the point of linearity, you sound worse and worse.

For the same reason, you can't use a class C amplifier on SSB or AM. If you intend to use your amp with a multimode rig, get one that is made for the different modes. The giveaway is the switch on the front labeled "FM/SSB" and, of course, a somewhat higher price tag. When using this amp, you have to be careful not to pump too much power from the transmitter into it, or you'll be right back sounding like a CBer. You also might get a "pink slip," which is a notice of violation from the FCC. Believe me, you don't want one of those!

Finally, remember that on VHF and UHF, signals normally don't go beyond about 1.3 times the distance to the horizon. Under unusual atmospheric conditions, you may experience long-distance communications, and higher power certainly helps in these rare instances. But, for normal "line-of-sight" communications, running 1000 watts won't significantly increase your operating distance. What *will* do it, though, is antenna height, because it increases the distance to the horizon. In fact, a significant increase in antenna height is much more valuable than a linear amplifier, and it usually costs less, too.

The Low Bands

Here, the situation changes entirely. Although there is some use for line-of-sight transmission, especially on 10 meters, most HF communication occurs through "skip," or ionospheric refraction of the radio energy.

When you're sending signals around the world, power really helps. We usually use SSB on the low bands, and that mode is like AM in two basic ways: First, your "loudness" does depend on your signal strength, at least to a point. Second, you must have true linearity in an amplifier or you'll make a mess.

What's important to realize, though, is that even on HF, increasing your power causes you to quickly reach a point of diminishing returns. That happens because radio works like sound in that perceived signal strength is logarithmic, not linear. What I mean is that it is the ratio of the new strength to the old one that counts, not the absolute number of watts. So, increasing your signal from 10 to 100 watts makes more difference than increasing it from 100 to 300 watts, even though the first change represents fewer overall watts. It works like this: Doubling your power increases the S-meter reading at the receiver by 3 dB. It takes 6 dB to make one S-unit. So, to really make much difference, you need to increase your power by perhaps a factor of 10, and that's a whale of an increase. Before you know it, you'll be running the legal maximum, and it probably isn't necessary in the first place. Under decent band conditions, 100 watts will get you around the world with no problem, and reducing your power to 50 watts probably won't even be noticeable to the other station!

Well, there's more to this topic, but I've run out of room, so I'll see you all next month. 73 from KB1UM. RF

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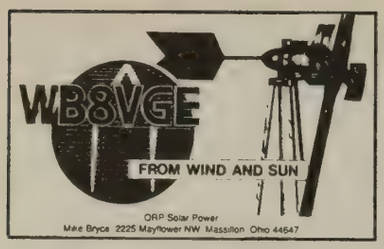

radio magic

by Michael Bryce WB8VGE

A Folded Dipole for 40 Meters

Antennas are always fun to build. This month I have a simple antenna project for you to build: a folded dipole. You can build this antenna from parts scarfed up from the local Radio Shack or hardware store. In fact, during a trip to the neighborhood K-Mart, I noticed they had all the parts except for the capacitors.

The folded dipole is a dipole folded back on itself. In other words, the top half (the second wire) of the folded dipole makes the current in the conductors of the antenna flow in the same direction. Because there are two wires, the current is equally divided between the two conductors in parallel. The current in each conductor is half the total amount. Think of it as two equal value resistors, both taking an equal amount of current from the supply. This makes the feedline "see" a higher impedance because it is delivering the same amount of current (in a regular dipole) at only half the current. If you add more wires, the impedance increases even more as the current is divided again. But, because we are using only two wires, the input impedance is very close to 300 ohms. That's an ideal impedance as we can now feed the folded dipole with standard 300 ohm TV twin-lead wire. See the drawing for a clear view of the current flow of the folded dipole.

The folded dipole has a much flatter impedance-vs.-frequency characteristic than a simple dipole. This means you will have a lower SWR from one end to the other end of the band. A folded dipole is also easy to build, and there are no special traps required for its operation.

A folded dipole will also allow operation on **odd** multiples of the fundamental frequency you're using. For example, if you make a folded dipole for 40 meters (7.000 MHz) you can also use the same folded dipole on 15 meters (21.00 MHz).

But, you can't use it on 20 meters (14.00 MHz) because 20 meters is an **even** harmonic of the fundamental frequency.

This antenna is ideal for portable use on the HF bands. It will perform much better than a random-length wire thrown in the trees and you don't need an antenna tuner either! Also, there is no need to carry a heavy coil of coax either, since you can feed the folded dipole with 300 ohm feedline and a short hunk of coax. Ideally, the folded dipole should be fed via a 1:1 balun, but there is really no need for it. I'll show you how to connect the coax directly to the twin-lead without a balun.

Construction

All you need to build your own folded dipole is some TV twin-lead, a tape measure, a capacitor, and some time. The first stop should be for the TV twin-lead.

You can get this stuff almost anywhere. Radio Shack carries several different type at several different prices. The price of the twin-lead will depend on how long you want the dipole to stay up. The "Shack" sells a package of mighty cheap semi-clear twin-lead for a couple of bucks. This stuff would be great for Field Day or other portable HF work. I would not want to use the cheap twin-lead for a permanent installation, however. But, don't get the shielded twin-lead either. It's not what you need. It looks just like the regular stuff except it has a shield around it. Radio Shack handles a middle-of-the-road twin-lead that's inexpensive and durable.

While you're there, pick up some heavy-duty tape and some silicon sealer (RTV) along with a short length of RG-58U coax. You'll also need one capacitor for this antenna. Normally, it's best to use a silver mica type, and they're not available at the Shack, but we can get by with a ceramic capacitor. If you're planning on running lots of power (over the normal 100 watt output) then plan to stick with the silver mica capacitor. The dipole we're going to make will cover the popular 40 (7.00 MHz) band and will require a 150 pF capacitor. You can "make" one by adding in *parallel* one 100 pF capacitor and one 47 pF capacitor. Radio Shack sells both values for under about a buck each.

You'll need two small pieces of insulator material. You can use plastic, nylon, a small hunk of sealed wood or use some PC board material. I chose the PC board material as there is always some laying around in my shack. If you have a piece of double-sided PC board, so much the better. Just use your VOM to make certain the two sides are not connected (by a sliver of copper) and you can use it to stiffen the electrical connections we'll make.

The antenna is made of two lengths of 300 ohm twin-lead. The ends are shorted together while a shorting strap is placed near each end. The diagram shows you the proper placement of these shorting straps.

To make the shorting straps, simply cut away at the plastic insulation and short out the top and bottom wire with a short length of wire. A resistor lead works great here. After you have soldered the shorting strap in place, apply some RTV sealer and allow it to cure. After it's dried, about 24 hours later, apply a layer of electrical tape to further protect the wire.

Add the shorting capacitor to the feedline stub at the location shown. Again, use the RTV sealer and tape to provide a waterproof connection.

Connect the coax to the twin-lead by soldering the braid of the coax to one wire of the twin-lead and the center conductor of the coax to the other lead. Use a piece of plastic or other insulator to give support to the connection and then apply a glob of RTV to seal it. Again, when the RTV is cured, add several layers of electrical tape.

You won't need to use end insulators on this antenna project. Just cut a small hole in the ends in the insulation. Insert your nylon cord through the holes and hoist it up! But don't pull too much on the ends . . . it's only TV twin-lead!

This is an antenna project in which a picture is really worth a thousand words. By following the drawings, you'll have no trouble with putting your own folded dipole on the air. RF

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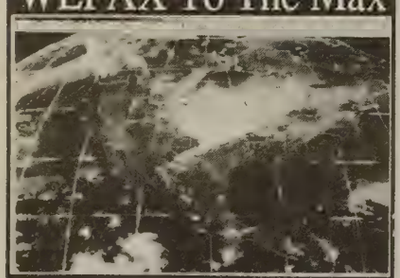

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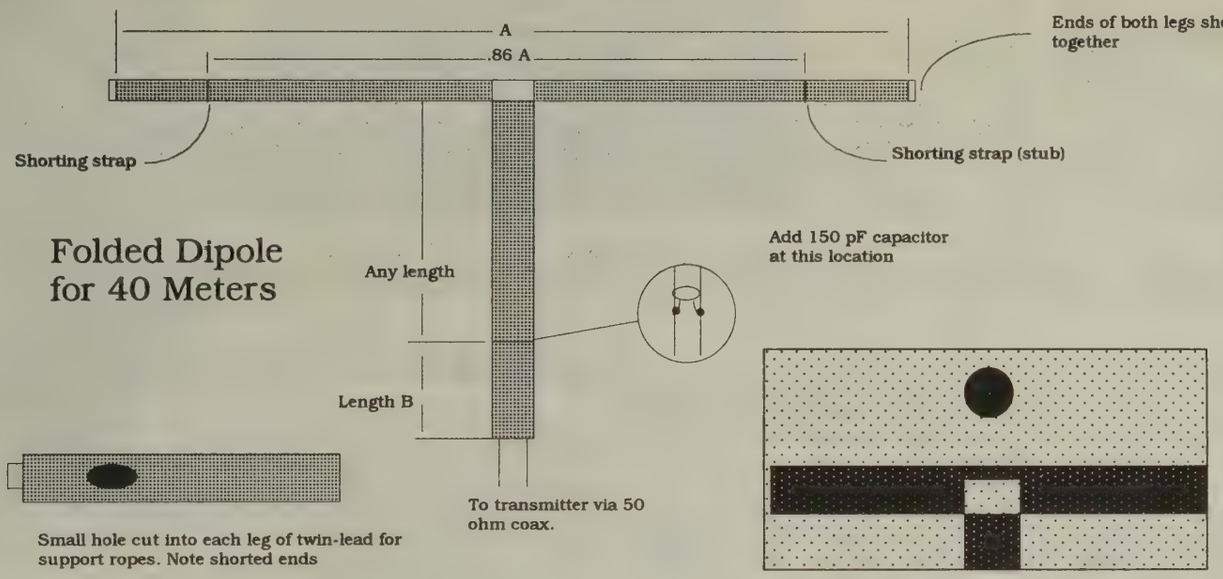
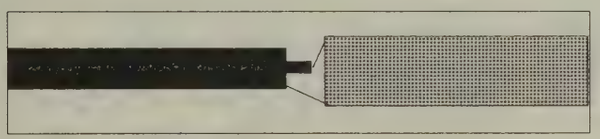


Folded Dipole for 40 Meters

Add 150 pF capacitor at this location

Small hole cut into each leg of twin-lead for support ropes. Note shorted ends

Small piece of plastic or other material to support the center of the folded dipole. Small hole may be drilled to support dipole in inverted VEE fashion if desired.



Use another piece of plastic to support the coax and the twin-lead so you can connect the two together. Apply RTV and after it is cured, wrap several layers of electrical tape on connection.

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antennas, etc.

by Joseph J. Carr K4IPV

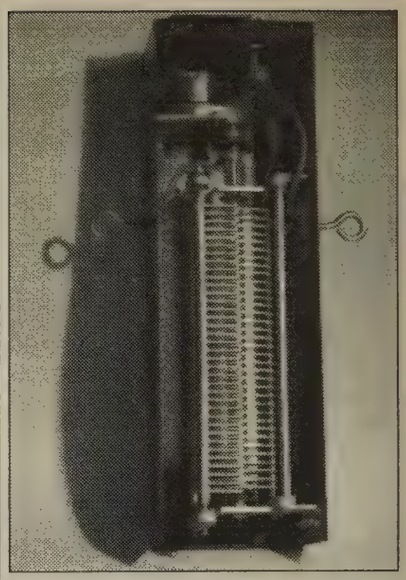

Photo A. Heathkit version of the tuner unit.

The Long and Short of It

The dipole antenna is a forever favorite with ham operators, especially in the high frequency (HF) bands, because it is low cost, easy to build, even easier to tune, and works pretty well (many a DXCC was earned with the little dipole, even though the "big guns" tend to use beams). The dipole consists of a half wavelength of wire (usually #12 or #14), broken in the center and fed with 75 ohm coaxial cable. In most cases today, a 1:1 BALUN transformer is used at the feed point of the antenna, which makes the real pattern closer to the textbook pattern.

Although the actual length of the dipole varies somewhat with location and installation (depending on what the antenna interacts with), it will be close to $468/f_{MHz}$, where f_{MHz} is the frequency in megahertz. On the 40 meter band, a dipole will be around 66 feet long, while on the 75/80 meter band it will be 133 feet long. These lengths are a little much for some people's property.

Another problem with the dipole occurs because it is a resonant antenna. That is, when you cut it and tune it for a specific frequency, it will not perform as well at other frequencies within the band removed from the tuned frequency. The antenna tuner at the transmitter end of the transmission line is not equipped to improve the antenna performance, only to prevent its malperformance from affecting the transmitter. The techniques in this month's column help deal with both problems: the long and short of dipole operation.

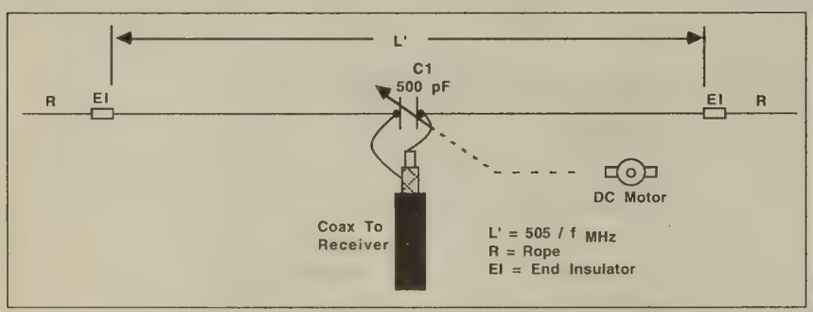

Figure 1. Capacitor tuned dipole antenna.

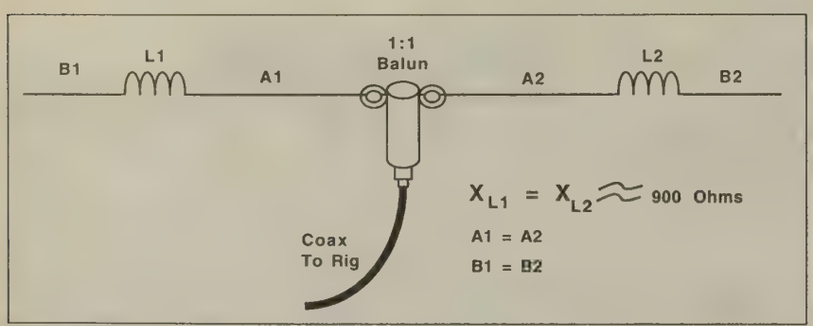

Figure 2. Shorty dipole uses inductors to make up for short length.

The Long of It

An antenna that is too long for its resonant frequency tends to look like an inductance to the transmitter. To tune such an antenna one inserts a capacitor in series with the radiator element, and then tunes the capacitor to electrically "shorten" the antenna. (With normally available variable capacitors it is reasonable to tune out lengths up to about 15 percent over the resonant frequency found from the formula above).

Figure 1 shows the use of a variable capacitor in series with the antenna. A value of about 500 pF is typically used, although higher and lower values will be used with an appropriate change in the range of tuning. With the capacitor shown, however, we can calculate a maximum length of $505/f_{MHz}$ and a tuning range of about 8 percent.

The capacitor shaft is turned by a small 1 to 2 rpm low voltage DC motor (DO NOT use a 110 volt AC motor . . . if the cabinet holding the capacitor leaks, then the AC will short and cause a fire and shock hazard).

Photo A shows a version of this tuner once offered by Heathkit. In the Heath version, a 500 pF transmitting variable capacitor is mounted inside of a metal cabinet along with a small DC motor. Unfortunately, this kit is no longer available. I have, however, seen these units at hamfests within the past couple of years . . . so I suspect that you will be able to find used ones at reasonable prices.

Unless you rig some means for placing the capacitor and motor assembly at midair when you install the dipole, it will be necessary to use a mast center support. If you want to keep it in the standard dipole configuration, then three supports are needed: one on each end and one in the center. If you want to use only one support, then make an inverted-vee dipole antenna. That is, elevate the center, and let the ends slope down to near the ground. The capacitor and motor assembly is placed at the head of the mast, close to the center feed point of the antenna.

If you want to build your own variable capacitor tuner, then you will have to obtain a variable transmitting capacitor. Try the catalog from Ocean State Electronics (P.O. Box 1458, 6 Industrial Drive, Westerly RI 02891; 1-401-596-3080 or, for orders only, 1-800-866-6626).

The Short of It

Okay, we've told you how to make the antenna tunable, but it is even longer than the standard dipole. How does the person with too little room make a dipole? It's easy: Make it shorter. Because the antenna that is too short for its resonant frequency it becomes capacitive, so an inductance must be placed in series with the antenna radiator element. Figure 2 shows a pair of coils placed in the centers of the two quarter wavelength radiator elements.

The inductance of the coils should be equal to each other, and for a half-sized dipole should have a reactance of about 900 ohms at the center of the desired band of operation. The inductance that will yield this reactance is found from $900/2\ f_{Hz}$, where f_{Hz} is the frequency in hertz (not MHz). For example, if you cut the antenna for 7.2 MHz, i.e. 7,200,000 Hz, use 19.9 µH.

Photos B and C show coils that can be used for making the inductors for the shortened antenna. The coils in Photo B are a commercial set, and are available from ham radio distributors. The coils in Photo C are made from B&W coil stock (Ocean State Electronics stocks these items also). The coil stock is mounted on the insulator used to separate the two halves of each radiator element.

For Further Reading

These antennas, as well as many other antenna topics, are covered in most reasonably complete antenna books. My books on the subject are *Receiving Antenna Handbook* (HighText Publications, 125 North Acacia Avenue, #110, Solana Beach CA, 92075; order from IPG on 1-800-888-4741) and *Practical Antenna Handbook* (TAB/McGraw-Hill, Blue Ridge Summit PA 17294; 1-800-233-1128). Both are available from Uncle Wayne's Bookshelf, *73 Magazine*, P.O. Box 3080, Peterborough NH 03458; (603) 924-4196, (800) 234-8458, Fax: (603) 924-8613.

Readers who want to submit article topics for this column, or ask questions, are encouraged to write to the author at P.O. Box 1099, Falls Church VA 22041. RF

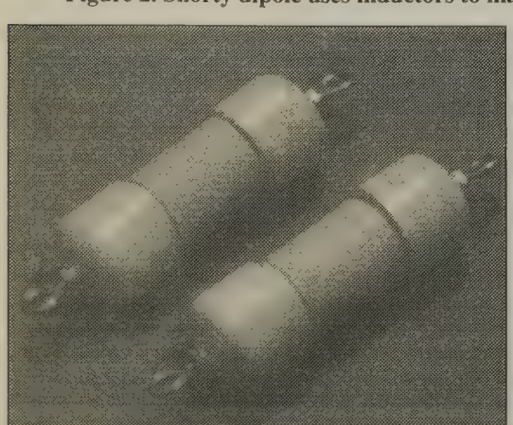

Photo B. Commercial short dipole inductors.

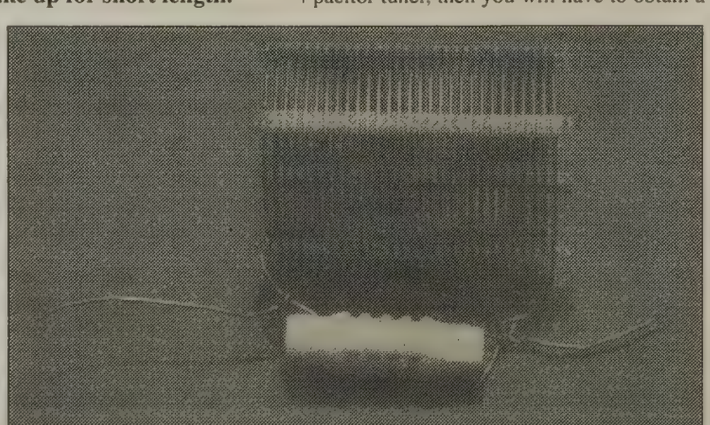

Photo C. B&W coil stock inductors mounted on an end insulator.

RF kit review

Oak Hills Research
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Big Rapids MI 49307
(616) 796-0920
Price Class: $198.95

Building the Oak Hills Research Spirit QRP Transceiver Kit

by Jeff M. Gold AC4HF

I finished assembling the kit the Friday night of the WPX CW contest. What better test of a new transceiver running only 5 watts than to go up against the big guns? I worked more than 125 stations with my 5 watts and a Gap vertical during this contest, including several Russian, Italian and French stations, along with Alaska, many assorted islands, and all over the lower 48 states. With practice, I received many returns on the first call. Not bad for 5 watts and a vertical.

When the kit came in the mail, I opened the box to check things out. There was a stack of stapled instruction sheets and large parts overlays. There was also a chart showing you how to read the resistor codes, a detailed and well-thought-out parts list, and schematics. There were many parts to this kit and the parts on the receiver board were densely packed. This kit was not difficult to build, but it's not a beginner's kit.

Putting It Together

The directions are not like the old Heath step-by-step approach. The first page gives general information about assemby, soldering, and dos and don'ts. The first step is to take careful inventory. Next, you need to find the receiver board and put in all the resistors, followed by the capacitors. The next steps do go through what you need to do in more detail. As the process itself becomes more potentially confusing, the directions get clearer.

After building a number of kits, I like this approach best. I first check off all the parts, then label them on a piece of paper and stick the wires through. This gives me a chance to make sure all the parts are included, familiarizes me with the parts and gives me a chance to double-check before putting the parts on the board. I check them once while I am going through the parts check off, and then again before I place them on the board. I found out that checking off parts is a worthwhile pain—when I do it this way, I don't have to go hunting for parts.

It took me quite some time and energy to sort out the parts since there were over 170 resistors in the kit. I found ALL the parts to be of top quality. The enclosure is excellent. I didn't see any hint of cutting corners in any piece included in the kit. I've built kits from practically every manufacturer out there, and I would have to rate the quality of these parts to be the best.

But it was the PC board that impressed me the most. It is a high quality board with plated through-holes. When you heat the joint the board sucks up the solder, so you will be proud to show either side of this board to anyone. My wife comments that while her needlework is beautiful on the front side, she woudn't show the back to anyone. Most of my projects are like that, but not this one. I felt like displaying the board in an art show. The silkscreening on the receiver board was just OK. I found out that I located one component in the wrong place because I couldn't read the part number. This wasn't really a big deal. The kit contains a nice clear parts overlay that makes it easy to identify parts placement.

The receiver board is packed with parts but the back of the board is laid out so that if you use a fine-tipped soldering iron you really shouldn't have any problems with solder bridges. The transmitter board was a lot less dense.

The keyer board isn't plated through and it's not close to the top quality of the other two boards. Be careful with this one. I found it was not nearly as much fun to solder to as the other boards. Still, I didn't have any problems with it.

Once I got the parts checked off and labeled, I found it very easy to assemble. After the instructions take you through installing all of the resistors and capacitors, they become more detailed and clear. Unlike Heath, there were no resistance checks, so when you are done you power up and pray. In this case, some "power off" tests would have been reassuring.

I was exremely careful with this kit, but I got a little too excited at the final assembly and put one teeny-weeny audio chip in backwards. Boy, did I feel dumb! When I powered up, the smoke came out. It failed the smoke test! Luckily, it was easy to spot the mistake and since the chip was on a socket, it was a breeze to correct. I checked the resistors and other parts that fed it and had no problem at all. A friend of mine has one of the best theories about the smoke. He states

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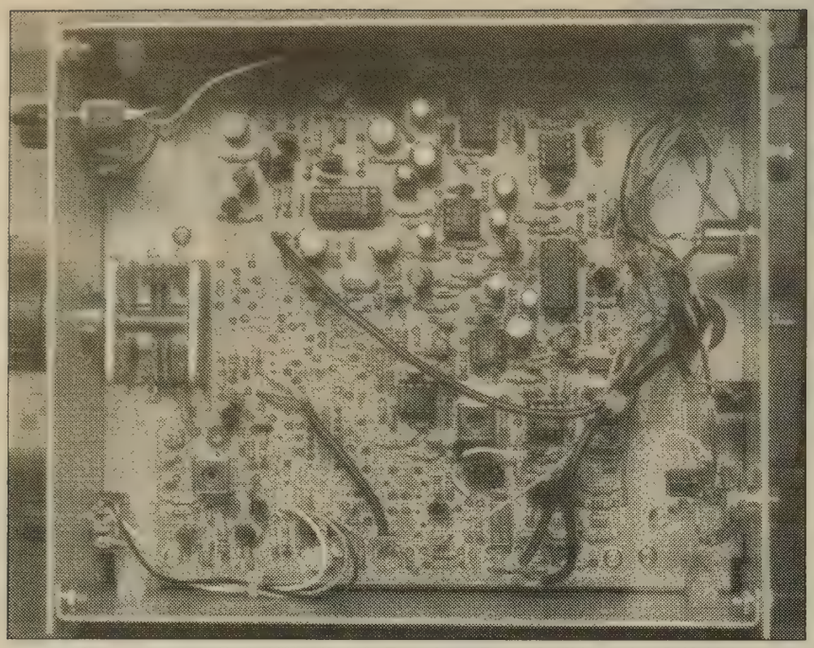

Photo A. The Oak Hills Spirit Receiver Board. (Photo by WS4S.)

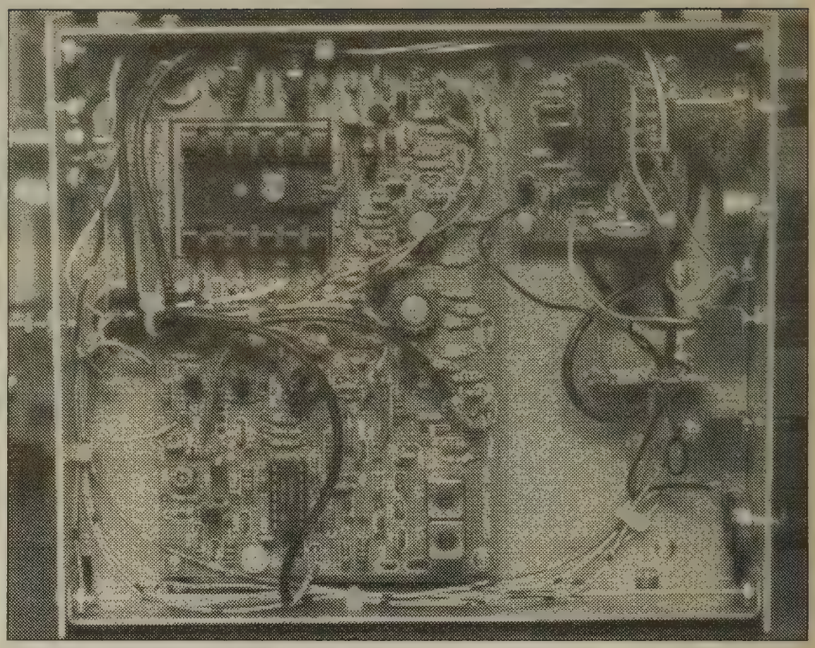

Photo B. The Oak Hills Spirit Transmitter Board. (Photo by WS4S.)

that all the components are actually filled with smoke and work fine this way. When you mess up something in the circuit, you allow the smoke to escape. When the smoke escapes, the part no longer functions and the circuit doesn't function. I have seen many examples of this, and watching the smoke go up from the audio chip and testing the circuit later convinced me of this theory.

If you are building the 20 meter kit, beware of the sections that are on the board for the other bands but are not used in the 20 meter version. The directions clearly explain this, but I mistakenly put some of them on the board anyway. The extra parts were included with the kit and the parts are labeled on the board, but Dick from Oak Hills said he was not going to include them in future versions to avoid this confusion. He also said he would be separating the parts lists for each of the boards, making it easier to check parts and build the kit. I found that I could call the toll-free number and get friendly, expert help whenever I need it.

The final alignment suggests using a frequency counter. I can't ever get the frequency counter in my MFJ antenna analyzer to read such low levels, so I use my 757GX as my alignment tool. You just need to set a coil and a capacitor to set the full 100 kHz bandwidth for the VFO. I took a piece of copper wire and stuck it in the antenna jack of my 757 and held the loose end over the oscillator circuit and it worked fine. The rest of the alignment procedure was as easy to perform. You tune the pitch of your TX out signal and the sidetone pitch. I once again used the 757, put both rigs on dummy load, transmitted and set the Spirit for the same note as the 757. I figured the Yaesu people knew what they were doing and had the proper equipment when they did it. For the TX alignment I used my Oak Hills QRP wattmeter and simply adjusted a variable resistor for power level and then two coils for maximum output. I spoke with Dick at Oak Hills, who suggested tuning it for the full 5 watts to get the best quality TX signal. Over the weekend I took the case off a few times and tweaked various things. After I was done aligning the VFO I found the tuning dial to be pretty accurate across the entire CW bandwidth for 20 meters.

A note about the keyer weighting adjustment: I started at the suggested middle position, and the keyer was acting really funky. I couldn't really set it right, but I adjusted the weighting adjustment on the keyer board and it now works perfectly. In fact, it's one of the better keyers I have used.

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A friend of mine said we should go into business and sell this thing but I said "No"! I am a ham and I'm not in this for the money. So we decided to have the plans printed and donate the profit to the ham clubs that helped us to begin with.

This is not really an ad; it can be called a fund raiser.

The antenna is a 4-element circular beam. The material cost is about $20 and it's cheaper to build two (so if the old hams help the new hams and the new hams help the old hams it will be a better world).

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band for the receiver bands you peak. I didn't have much audio level to my speaker, so I reread the instructions. They cautioned about being on the right sideband. There were clear instructions about how to tell if you're on the right sideband. I went back and readjusted the receiver and it corrected the problem.

How Does It Work?

The real question is how it works on-the-air. The rig puts out a full 5 watts. I turned mine back from a little over 6 watts. The keyer works real smooth and has full break-in QSK.

The receiver at first deceived me during the WPX contest. The bands were really crowded at my QTH. The big guns were using big ammo. It worried me that this rig doesn't have a narrow and wide CW filter switch. During contests it is real nice to have a narrow filter available. I tuned around and noticed that when the receiver got a signal, you really only heard that one signal. At first I thought that this was caused by poor receiver sensitivity. After spending the entire weekend of the contest testing the rig out, I found that if I could hear them on the other rig, I could hear them on the Spirit without interference from nearby stations.

One comparison I made was finding a station on the 20 meter band that was coming in at about 559. The band was noisy. With the Yaesu in the wide position, the Spirit was receiving better and with a lot less noise. With the Yaesu in the narrow filter position, they were almost equivalent, but the Spirit's receiver was a little quieter. I even had the Yaesu preamp on at the time. I compared the Spirit to a few other QRP rigs that I've built and was really impressed with the Spirit's receiver.

If I had designed the kit I would have left out the AGC and the RF controls and made the keyer an option. The kit could then fit in a smaller case. The rig is just a bit too big and heavy for a backpack rig. It is little smaller than my HW9. I think Oak Hills can keep the best parts of the receiver design, get rid of the extras, add an S-meter and really have a winner.

I think this rig points out a couple of important facts about QRP operation. First, QRP doesn't mean you are going to struggle to make contacts. Many times the QRP signal will only be 1 to 2 S-units lower than a rig running 100 watts. Second, QRP doesn't mean poor quality equipment. Third, you can build a quality station yourself. For station or portable operation this rig is excellent. It is a pleasure to both transmit and receive using this rig. RF

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Superhet receiver with diode ring mixer and RF preamp

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QSK

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12 VDC

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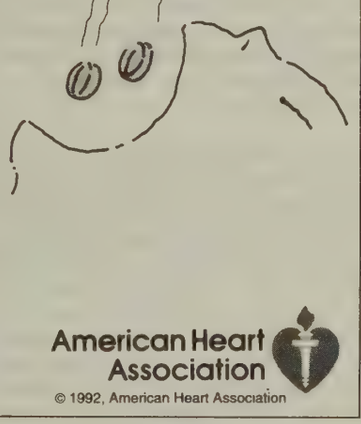

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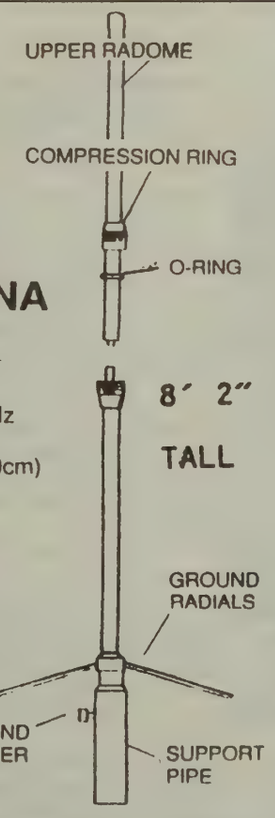

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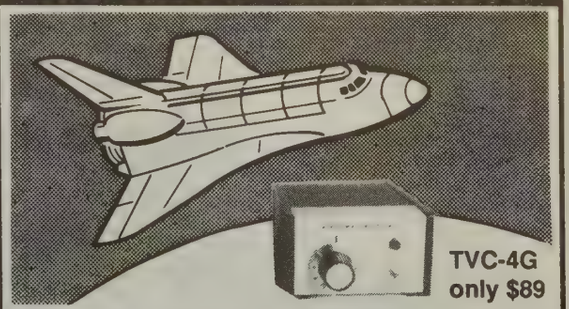

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Before I tell you about all of the excitement on 10 GHz, and where to buy ready-made equipment, I would like to issue the following statement:

CAUTION: NEVER STAND IN FRONT OF, OR LOOK INTO, 10 GHz WAVEGUIDE OR HORN ANTENNAS!

The 10 GHz band operates at roughly the same wavelengths that your microwave oven works on. If you were to put a hotdog on a high power 10 GHz station, you'd watch the wiener cook! Always stay away from the "business end" of any 10 GHz dish or horn antenna system.

What's up on 10 GHz? For one thing, propagation beacons may be found between 10,368.300 MHz and 10,368.400 MHz. These unattended automatic beacons transmit their CW identifier, which might be received throughout the entire city. The nature of 10 GHz signals is to become ultra-reflective in downtown areas, allowing these microwave emissions to be heard in locations where 2 meter radio waves won't make it. This is the same reason why FM music stations often propagate well into long tunnels, while lower frequency AM signals instantly disappear.

Equipment

For more than 10 years, fully-assembled FM wideband transceivers for 10 GHz have been offered by Advanced Receiver Research (P.O. Box 1242, Burlington CT 06013; 203/582-9409). For the beginner, this equipment instantly gets you onto the same frequencies as the *real* 10 GHz experts; those veteran hams who built their rigs out of converted security sensors. The ARR system has everything you need to get up on 10 GHz, wideband FM—just add 12 volts and a crystal microphone and you are on the air. I have personally worked over 100 miles on 10 GHz wideband FM, and almost every major city in the country has a small group of hams who love to microwave on the weekends!

Photo A. Gordon West WB6NOA tuning the Advanced Receiver Research 10 GHz wideband FM system.

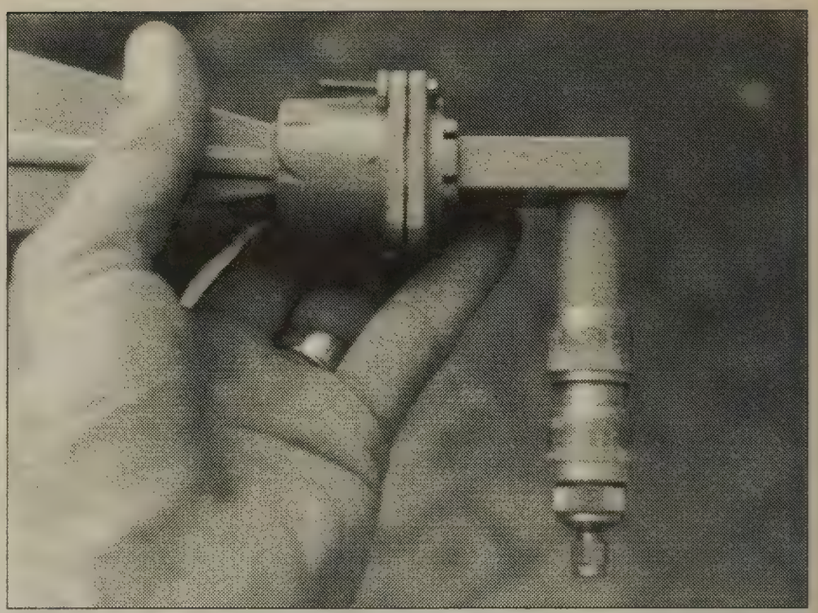

Photo B. Operating at 10 GHz usually requires a waveguide-to-N-to-SMA connector assembly like this.

But to work extra long-range on these extremely high frequencies, you will need to graduate into a 10 GHz system that will operate CW and SSB. There is no easy way of converting wideband FM equipment over to 10 GHz sideband, either.

So who makes a 10 GHz *SSB* transceiver, all put together, and ready to go? No one yet. But, if you are good at home-brewing pre-assembled modules for 10 GHz, you may wish to consider the following manufacturers:

Down East Microwave
P.O. Box 2310, RR 1
Troy, ME 04987
(207) 948-3741

SSB Electronics
124 Cherrywood Drive
Mountaintop, PA 18707
(717) 868-5643

Each of these companies has equipment for modules to develop a "transverter" for 10 GHz CW and SSB operation. So what is a "transverter," you ask? Good question.

The transverter will take the incoming 10,000 MHz signal and conVERT it down to 144 MHz, or down to 28 MHz for equipment you may already have on hand. And on transmit, the transverter conVERTS an outgoing signal on 28 MHz or 144 MHz up to your desired operating frequency at 10,000 MHz. All this takes place in a chassis sized similarly to your mobile 2 meter transceiver. And inside the chassis are individual shielded modules that you can buy preassembled, or (if you are *really* technical) put together yourself. For the newcomer, go with the preassembled building blocks!

So picture the transverter in between your existing high frequency or VHF transceiver and a simple horn antenna on the transverter's output. But, while this all sounds simple, there are additional important considerations for those of you considering a transverter.

Most transverter input circuits won't tolerate more than a fraction of a watt of power. This means you will need to modify your 2 meter or 28 MHz SSB equipment to put out no more than approximately 100 miliwatts (0.1 watt) on high power transmit. On the Kenwood TKM-751 all-mode 2 meter transceiver, the technical ham can temporarily disable the power output transistor, and this will save you from blowing your new transverter!

Another important consideration is the transverter's switching system. When you key your local transceiver, the transverter MUST switch over to accept the transmit signal. If it doesn't, you instantly blow the transverter's receiver section. Luckily, the Kenwood 751 has keying contacts on the back of the rig ideal for cycling the transverter over from receive to transmit.

A third consideration is adapting the transverter's SMA output over to waveguide to accommodate your small 10 GHz horn. The WR-75 waveguide adapter that terminates to an "N" connector or SMA connector is a fine way to go. If your horn is lightweight, it won't mechanically stress the small SMA connector. Be careful—this is a fragile point on the transverter.

And last, but certainly not least, you need some sort of an SSB high frequency or VHF rig to make this entire transverter kick your local signal up to 10,000 MHz. An FM-only rig won't cut it. You need something with SSB.

Once you get up on 10 GHz, get set for some excitement! On hot windless days during periods of tropospheric ducting, your 10 GHz signals could easily travel well over 200 miles. If you are working a station at the other end of the circuit with a big dish antenna, all the better! They will hear your little 1/10th of a watt output signal into that tiny horn loud and clear over a surprisingly long distance.

You will find that fog and wet weather will dramatically decrease the 10 GHz communications range. As soon as the air begins to hold moisture, your communications range will take a nose dive to no more than 10 or 20 miles. That's why 10 GHz contests are always held in the fall when temperature inversions are most likely to occur across the United States.

Even if you are a beginner in ham radio and don't have a lot of technical background, you can still put together a 10 GHz system by the modular approach. Jerry at SSB Electronics enjoys working with newcomers to the microwave hobby. And more and more beginners are choosing his kits because the inside modules are preassembled, and the main job is simply following the diagrams to do your "plumbing."

So now that many 10 GHz wideband FM operators are switching to SSB, they may be letting go of their wideband FM equipment on 10 GHz for a song. This could be a good deal for you to take advantage of. See you on 10,000 MHz! RF

what's next?

by Carole Perry WB2MGP

Hooked on Ham Radio

One of the things I enjoy most about amateur radio is the really terrific people I continually get to meet both on the air and in person at ham radio gatherings all across the country. One super dynamic lady, who refers to me as "cousin" since we share the same last name, is Sheila Perry NØUOP, a teacher in Bloomfield, Missouri. Sheila has kept in touch with me for over a year now, calling and writing to get help with establishing an amateur radio club in the third grade at her school.

I knew, just from speaking with Sheila on the phone, that this lady would be successful in motivating youngsters with amateur radio in the classroom. An enthusiastic teacher is always important in the learning process, but it's vital when working with children. Sheila's newsletter and radio project were funded by a federal Christa McAuliffe Fellowship grant. Sheila wrote a little article about getting "hooked" on ham radio in the newsletter. I'd like to share some of it with you. She makes an interesting comparison with the acquisition of a credit card. Those of you who are instructors or teachers might like to borrow her comparisons for your own radio groups.

"The experience was the same as when I received my first credit card. I was eager, powerful, ready to use it for the first time.

"NOW I'M A HAM!! Finally, after two years of struggling, writing grants to fund my dream, researching, contacting Elmers, getting other people involved, and keeping my fingers crossed, I made it. Like with a credit card, I filled out the application papers and received a license of my very own.

"Just like with my credit cards, the excitement of doing something on my own was evident. Using the radio was the same as using the credit card: You can't stop after the first contact—you love to use it over and over.

"And, just like with a credit card, you have a limit. Ah, but with a credit card, when you hit the limit, they raise it or stop you. With amateur radio, no one stops you and you love finding out your limit has been raised. There are new hams to talk to that you weren't aware of, new places to locate on a map, and new worlds to explore.

"Just like with a credit card, you get pestered every month by someone wanting something. Except in radio, you love to be pestered, and you love to give something back. With credit cards, you worry when you make a major purchase; will it go through? Will they accept it or cut it up? Not so in amateur radio. Every ham will accept you and your students. You'll always make it through.

"With credit cards, your own children are smart. They want something, and you tell them you're broke. In unison, they'll yell at you to charge it. They want to use your credit card all of the time. Same with amateur radio. Your students don't care about your lesson plans for the day. They want to use the radio all the time.

"And what about those hated past due notices you receive? The ones you know you've paid, but you just haven't gotten around to mailing yet? You'll love hearing another ham ask where you've been so long.

"Another embarrassing moment is when your card has either expired or you've grabbed your husband's by mistake. (Was it really a mistake?)

"With your ham license, you have your own callsign and you will never forget it. You'll memorize it the first day you receive it. Who does that with a credit card?

"Sure, your credit cards can take you places you've never been before. But so can ham radio. And at a lot cheaper price. You can explore new worlds, seek out new life and new civilizations, and boldly go where no one has gone before. Try that with your charge card.

"So if you haven't explored this fascinating adventure with your family or students, try it. Like the commercial states, you'll keep going, and going, and going . . . "

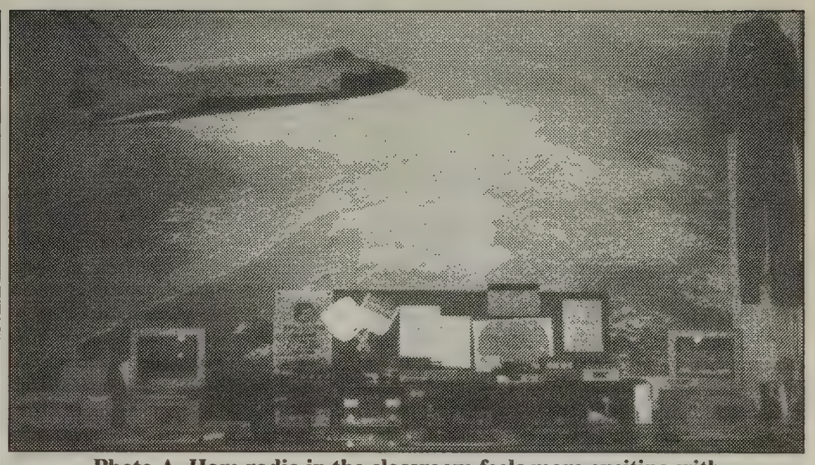

Photo A. Ham radio in the classroom feels more exciting with this space shuttle mural as a backdrop.

"A Touch of Space" Amateur Radio Club

Sheila has put together a wonderful Teacher Resource Center where she lists those materials that have aided her in her radio work for the classroom. She endorses *RadioFun*, as do I, because "It is written on an easy-to-understand level, and it always has something about kids in it."

In her classroom, they use the shuttle mural as the backdrop for the hamshack. Computers are used for satellite tracking, packet radio, bulletin boards, and code practice. Four other teachers have joined Sheila and have received their amateur licenses. In the future, they hope to get involved with SAREX and give the children a chance to speak directly with the astronauts.

If you're planning on using amateur radio in the classroom this fall, please join teachers like Sheila and myself on the CQ All Schools net on Tuesdays and Thursdays at 17:30 UTC on 28.303 MHz (if you don't hear anything after 10 minutes, try 21.325 MHz; and after 10 minutes, 14.325MHz). Listen up for net controls Carole WB2MGP, Gordon WB6NOA or Jim N4MDC. RF

activities calendar

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202-N, Peterborough NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

SEPT 5

BURLINGTON, IA The Iowa-Illinois ARC Inc. will host "Burlington Hamfest '93" from 7:30 AM-3 PM, at the Iowa Army Nat'l. Guard Armory. Summer St. Rd. (across from Burlington Municipal Airport). VE Exams. Talk-in on 146.790/.190 W0LAC/R. and 146.520 simplex. Get details from *Chuck Gysi N2DUP, Burlington Hamfest '93, P.O. Box 911, Burlington IA 52601-0911. Tel. (319) 752-3000.*

SEPT 9-12

FORT MONMOUTH, NJ Members of the WW II Electronic Training Group will be holding a four-day reunion. Details are available from *Harrison W. Moore, Jr., COL SIG C (Ret), 260 Millard Ave., No. Tarrytown NY 10591. Tel. (914) 631-3683.*

SEPT 11

BALLSTON SPA, NY Saratoga County R.A.C.E.S. Assn., Inc. will hold "Hamfest 93" at the County Fairgrounds from 7 AM-3 PM. Talk-in on 146.40/147.00 and 147.84/.24 WA2UMX/R. Contact *N2FEP, P.O. Box 41, Rock City Falls NY 12863.*

ERIE, PA The Radio Assn. of Erie will sponsor "Erie Hamfest '93" at the Franklin TWP Fire Hall, from 8 AM-2 PM. VE Exams at 9 AM at Franklin Center Methodist Church, Rt. 98 (1 mile north of Hamfest). Talk-in on 146.01/.61. Contact *Erie Hamfest '93, Tom McClain N3HPR, 3954 Solar Dr., Erie PA 16506. Tel. (814) 833-1640.*

HARMONY, NJ the "Flemington Fallfest" will be held by the Cherryville Repeater Assn. from 8 AM-2 PM at the Warren County Fair Grounds, Route 519. VE Exams. Talk-in on 147.375+ and 146.820-. Contact *Keith Burt KF5FK, P.O. Box 308, Quakertown NJ 08868-0308. Tel. (908) 788-4080.*

CHANUTE, KS Chanute Area ARC will sponsor a Hamfest at North Malcolm Community Center from 8 AM-3 PM. Contact *Jon Wood W0UHL, RR2 Box 163A, Chanute KS 66720.*

SEPT 12

FINDLAY, OH This year the Findlay RC is having its 51st annual Hamfest at the Hancock County Fairgrounds, East Sandusky at Fishlock. Talk-in on 147.15+ mc rptr. Call *(419) 423-1440* for details.

JOLIET, IL The Bolingbrook ARS will hold its 8th annual Hamfest/Computer Fair at Inwood Rec. Center, 3000 W. Jefferson St. (Rt. 52), beginning at 8 AM. VE Exams for all classes, from 9 AM to Noon. Table Reservations: *Ed Weinstein WD9AYR, 7511 Walnut Ave., Woodridge IL 60517. Tel. (708) 985-0527.* For more info, call *(708) 739-9309.*

MONETT, MO The Ozarks ARS will hold its annual Picnic and Swapfest from 8 AM-2 PM at the Monett City Park, located at the intersection of Hwys. 39 and 60. Talk-in on 146.97- and 146.52. Contact *Gary Meyers, 1201 S. Madison, Aurora MO 65605. Tel. (417) 678-3376.*

OLD WESTBURY, NY The Long Island Mobile ARC will sponsor a Hamfest at the New York Institute of Technology, Route 25A, from 9 AM-4 PM. Talk-in on 146.25/.85 Contact *Neil Hartman WE2V, (516) 462-5549.*

SOUTH DARTMOUTH, MA The South Eastern Mass ARA will hold their 6th annual Hamfest & Flea Market from 8 AM-3 PM at the Club grounds at 54 Donald St. Talk-in on 147.00/.60. Contact *Michael Enos. P.O. Box 79064, North Dartmouth MA 02747.*

SEPT 17-19

VENTURA, CA The American Radio Relay League Southwestern Div. Convention Keynote Address (The Search for Extra Terrestrial Intelligence: or, Chasing the BIG DX) will be given by Dr. D. Kent Cullers WA6TWX, at the Ventura Holiday Inn, as a part of "HamVenture '93." For more details write to *HAMVENTURE '93, P.O. Box 3000-267, Santa Barbara CA 93130.*

SEPT 18

BERWICK, PA A Hamfest/Computerfest will be held, starting at 8 AM, at the Beach Haven Carnival grounds by the Columbia Montour ARC. VE Exams at 1 PM (by advanced registration only). Talk-in on 147.225 (+600) or 146.52 simplex. For info, reservations, call *Dave WC3A at 717-752-6851.*

GLORIETA, NM The Northern New Mexico ARC invites you to attend their annual Hamfest which will be held in the Aspen Bldg. from 8:30 AM-4 PM at the Glorieta Baptist Conf. Center.

Continued on page 28

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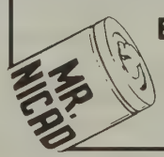

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Radio Fun flea market

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 30,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar, and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *Radio Fun Flea Market* costs you peanuts (almost)—comes to 25 cents a word for individual (non-commercial) ads, and 80 cents a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple of months before the action starts; then be prepared. If you get too many calls, you priced it too low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right, and julybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using.

Send your ads and payment to *Radio Fun Flea Market*, Judy Walker, 70 Route 202 N, Peterborough NH 03458, and *get set for the phone calls.*

The Deadline for the October 1993 Flea Market is August 25, 1993.

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RCI-2950 OWNERS: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT**, PO Box 510408, St. Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. RF515

INEXPENSIVE HAM EQUIPMENT. Send stamp for list. WA4DSO, 3037 Audrey Drive, Gastonia NC 28054. RF559

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activities calendar

Continued from page 27

Talk-in on 146.52 simplex, 145.19- or 147.30+. ARRL VE Exams for all classes; to register contact *Bonnie Griffiths KD0JQ, 190 Manhattan Loop, Los Alamos NM 87544. Tel. (505) 662-9155.* Flea Market contact: *Helenrose Burke W5IXS, P.O. Box 73, Ojo Sarco NM 87550.*

GONZALES, LA The 1st annual "Gonzales Hamfest 93" will be held at Gonzales Rec. Center from 8 AM-3 PM. Sponsored by the Ascension ARC. Talk-in on 147.225+, CTCSS 107.2. Contact *Wayne Russell, 40390 Sycamore Ave., Gonzales LA 70737. Tel. (504) 622-3964.*

SEPT 18-19

PEORIA, IL The Peoria Area ARC will sponsor the 34th annual "Peoria Superfest" at Exposition Gardens, Northmoor and University Sts., beginning at 8 AM. Talk-in on 146.76/R. Contact *The Peoria Area ARC, Box 3508, Peoria IL 61612-3508. Tel. (309) 685-6698.*

SEPT 19

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club, will hold a Flea Market from 9 AM-2 PM at Albany and Main Sts. Talk-in on 146.52 and 449.725/ 444.725 pl 2A W1XM/R. Contact *W1GSL, P.O. Box 82 MIT BR., Cambridge MA 02139. Tel. (617) 253-3776.*

MT. CLEMENS, MI The 21st annual L'Anse Creuse ARC Swap and Shop will be held from 8 AM-2 PM (EDT) at L'Anse Creuse High School. VE Exams at 11 AM; contact *Don Olszewski WA8IZV, (313) 294-1567; Prodigy #SSTG41A.* Talk-in on Echo Rptr. 147.08/.68 MHz or on 146.52 MHz simplex. Flea Market contact: *Ted MacKinnon NW8W, 19534 Warick, Beverly Hills MI 48025-3970. Tel. (313) 647-1628, ((517) 595-2309 from 6/28/93 to 8/21/93). (Compuserve 71303,2244).*

SANDYHOOK, CT The Candlewood ARA will sponsor an ARRL sanctioned Hamfest at the Sandyhook Firehouse, beginning at 8 AM. Talk-in on 147.12. Contact *Candlewood ARA, P.O. Box 3441, Danbury CT 06813-3441. Tel. (203) 438-6782; (203) 792-1845; (203) 426-1652.*

SEPT 24-26

WICHITA, KS The 1993 Kansas State ARRL Hamvention will be held for 3 days at the Ramada Broadview Hotel on Douglas and Waco Sts. ARRL/VEC Exams. Saturday Banquet. Contact *Len Warren N0QHZ, 6233 Millsboro, Wichita KS 67219-1637. Tel. (316) 744-1930.*

SEPT 25

DANVILLE, VA The Danville-South Boston Hamfest will be held at the Nat'l. Guard Armory. W5YI Exams on a pre-registration basis. Get details from *Bonnie Manasco AB4KO, 2107 S. Boston Rd., Danville VA 24540. Tel. (804) 822-6070 (work); (804) 822-5345 (home).*

ELMIRA, NY The Elmira ARA will present the 18th annual Internat'l Hamfest at the Chemung County Fairgrounds, Horseheads NY, from 6 AM-5 PM. Loads of events. Talk-in on 147.96/.36 or 444.20 Rptr. Contact *Dave Lewis, RD1 Box 191, Van Etten NY 14889. Tel. (607) 589-4523.*

SEPT 25-26

YORK, PA The 38th annual York Hamfest/Computer show will be held at the York Fairground on Rt. 74, Carlisle Ave., from 8 AM-4 PM each day. Table contact: *(717) 764-4805.* Talk-in on 146.37/.97. VE Exams Sat. only, at 9 AM. For info, write to *York Hamfest, P.O. Box 351, Dover PA 17315.*

SEPT 26

ADRIAN, MI The Adrian ARC will hold their 21st annual Hamfest/Computer Show at Lenawee County Fair Grounds from 8 AM-2 PM. Walk-in VE Exams. Talk-in on 145.370. Contact *Dennis Boydston WE8Z, 2383 E. Clearview Dr., Adrian MI 49221. Tel. (517) 265-8054.*

BUTNER, NC The Falls Lake ARC will sponsor its 2nd annual Hamfest at NCNG Armory from 8 AM-4 PM. Contact *Fred KC4VSO, FLARC, P.O. Box 502, Butner NC 27509. Tel. (919) 575-4262.*

CLEVELAND, OH The Hamfest Assn. of Cleveland, Inc., will present The Cleveland Hamfest and Computer Show at the Cuyahoga County Fairgrounds, Berea OH. Doors open 8 AM-4 PM. VE Exams. Talk-in on 146.73, 6 AM-12 PM. Banquet Sat. night. Speaker TBOA. Write to *C.H.A., P.O. Box 81252, Cleveland OH 44181-0252.*

LONGMONT, CO The Boulder ARC will host its Amateur Radio Electronics/Computer Swap Meet at the Boulder County Fairgrounds Exhibition Bldg., Nelson and Hover Rds. Doors open at 8 AM. For VE Exams/Table Spaces, call *(303) 440-3627.* Mail reservations (deadline Sept. 18th) to *BARCFEST, 726 19th St., Boulder CO 80302.* Talk-in on 146.70.

ST. PETERS, MO The 9th annual St. Peters ARC Swapfest will be held in the rear parking lot of St. Charles County Community College, from 7 AM-1 PM CST. Talk-in on 145.41 MHz and 444.275 MHz. Contact *Walt Franzer WX0C, 1333 Pegasus Trail, St. Peters MO 63376. Tel. (314) 278-1993.*

SPRINGFIELD, IL Sangamon Valley RC Hamfest will be held at Sangamon Co. Fairgrounds in New Berlin from 8 AM-1 PM. VE Exams 8 AM-9:30 AM. Statewide Packet BBS meeting at 11 AM. Talk-in on 147.315-, 224.68-. Contact *Don Pitchford WD9EBK, RR#1 Box 104, Springfield IL 62707. Tel. (217) 789-4519.*

YONKERS, NY The Giant Electronic Fleamarket, sponsord by Metro 70cm Network, will be held at Lincoln High School on Kneeland Ave. from 9 AM-3 PM, rain or shine. VE Exams. Talk-in on 440.425 MHz pl 156.7, 223.76 MHz pl 67.0, 146.91/.31 Rptr., 443.350 MHz pl 156.7. Contact *Otto Supliski WB2SLQ, (914) 969-1053.*

OCT 2-3

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Convention will be held at the Commonwealth Convention Center, downtown Louisville, Sat. 8:00-17:00, Sun. 8:00-15:00. Contact *Greater Louisville Hamfest Assn., P.O. Box 34444-S, Louisville KY 40232-4444. Tel. (502) 551-4118.*

VIRGINIA BEACH, VA The Virginia Beach Hamfest and ARRL Virginia State Convention will be held at Virginia Beach Pavilion. Commercial vendors contact *Lewis Steingold W4BLO, 3449 Dickens Dr., Virginia Beach VA 23452. Tel. (804) 486-3800.* VE Exams by the South Peninsula ARC on Oct. 3rd.: call *Ed Brummer W4RTZ, (804) 898-8031.*

OCT 3

HUNTINGTON, IN The Huntington County ARS will sponsor its 5th annual Hamfest from 8 AM-2 PM at the PAL (Police Athletic League) Club in Huntington. VE Exams. Talk-in on 146.085/.685 and 448.975/443.975. Contact *Ray Tackett KC9DZ, 420 Market St., Andrews IN 46702.*

MANSFIELD, OH The AAARC will host the North Central Ohio Hamfest from 8 AM-3 PM, at the Ashland County Fairgrounds. Talk-in on 147.105+. Contact *Wally Green W3YXS, (419) 281-3903.*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. Doors open 9 AM. Talk-in on 444.200 WB2ZZO Rptr., and 146.52 simplex. Contact (night time only) *Arnie Schiffman WB2YXB, (718) 343-0172,* or *Charles Becker WA2JUJ, (516) 694-3955.*

SPRINGFIELD, OH The Independent Radio Assn. will hold its annual Springfield Ohio Hamfest/Computer Show from 8 AM-4 PM at the Clark County Fairgrounds. Talk-in on 145.45 and 224.26 MHz. For reservations, write to *Independent Radio Assn., P.O. Box 523, Springfield OH 45501 (SASE);* or call *Carl Patterson KA8LGS, (513) 323-6680.*

SPECIAL EVENT STATIONS

SEPT 4-14

McDERMOTT, NV The O.I.N. 3 States DX-pedition, sponsored by the Vancouver Mountain RC, will operate W7WY from the state line of Oregon, Idaho, and Nevada. Operations will be CW and phone, 160 thru 10m, 24 hrs a day in the General portion of the band; also 12, 17, and 24m. For a certificate or QSL card, send an 8" x 12" SASE to *Vancouver Mountain Radio Club, W7WY, P.O. Box 1622, Vancouver WA 98668.*

SEPT 8-16

KIOWA, KS The Salt Plains RC will operate WA0HIH/W100CS, to commemorate the 100th Anniversary of the opening of the Cherokee strip land rush into Oklahoma. Special QSL by #10 SASE. Frequencys: +/- 20 kHz, 3.900, 7.235, 14.250, 21.325 and 28.500. Contact *Kiowa Cherokee Strip Centennial, 717 Coats, Kiowa KS 67070.*

SEPT 10-12

NORWALK, CT The Greater Norwalk ARC will operate KA1OFN Sept. 10 2100Z-2100Z Sept. 12, to celebrate the 17th annual Oyster Festival and the 125th Anniversary of Sheffield Island Lighthouse. Operation will be in the lower 25 kHz of the General 80, 40, 20, and 15m phone subbands, and the Novice 10m phone subband. For a certificate, send QSL and SASE to *Greater Norwalk ARC, c/o Norwalk/Wilton Red Cross Bldg., 43 North Ave., Norwalk CT 06851.*

PORT TOWNSEND, WA Jefferson County ARC will operate at the Port Townsend Wooden Boat Festival, between 1700 UTC and 2400 UTC, on the General bands for 15 and 20m, and 28440 on 10m. The event station, W7LD, will reciprocate with an event QSL card. Send QSL and SASE to *Olly Gardner KA6OZZ, Box 65156, Port Ludlow WA 98365.* Contacts will be made with Marine Nets.

TULELAKE, CA The Keno ARC will operate Station WD6EAW at the Tulelake-Butte Valley Fair. Operation will be in the lower portion of the General bands from 1600Z-2400Z. For a special QSL card, send an SASE to *WD6EAW Special Event, P.O. Box 653, Keno OR 97627.*

SEPT 10-13

PUT-IN-BAY, OH Members of the Oliver Hazard Perry Expeditionary force will operate KB8BN to commemorate the 180th Anniversary of the "Battle of Lake Erie." Frequencies: 7.240, 14.240, 21.365, 28.365. For a certificate, send QSL and 9" x 12" SASE to *Commodore Jim Yoder KB8LDG, 11796 Shadybrook Dr. NW, Pickerington OH 43147-9122.*

HIGHLANDS, NJ The Ocean-Monmouth ARC (OMARC) will operate 1600Z Sept. 11-1600Z Sept. 12, to commemorate the Marconi Memorial Twin Lights Lighthouse Radio Site. CW - up 10 kHz from bottom of Novice subbands; 10.145, 14.045, 18.080 MHz; bottom of General 80-15; Novice 10m phone subbands. For a certificate, send 9" x 12" SASE (or $1 U.S.) to *OMARC, P.O. Box 75, Bradley Beach NJ 07720.*

SEPT 12-30

OAK RIDGE, TN The Oak Ridge ARC will sponsor a second Special Event, on all bands, to commemorate the 50th Birthday of the City of Oak Ridge, the site of the original Manhattan Project. "We were born of War, are Living for Peace and Growing through Science." A four color certificate is available. Please SASE to operators' home call. RF

Uncle Wayne's Bookshelf

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6+ wpm—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are set at 13 wpm and spaced at 5 wpm.

73T13 **"Back Breaker" $5.95**
13+ wpm—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per.

73T20 **"Courageous" $5.95**
20+ wpm Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per.

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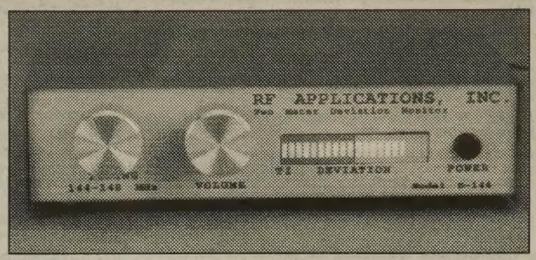
new products

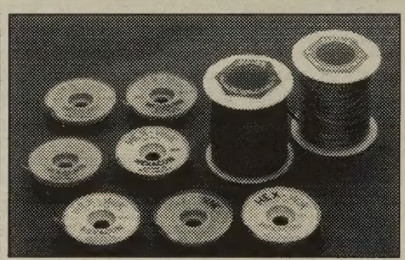
RF APPLICATIONS, INC.



The RF Applications, Inc. Model D-144 Two Meter Deviation Monitor provides an inexpensive, quick and easy way to measure the deviation of narrowband FM signals. Compliant with FCC Part 15 Subpart C as a communications receiver, the D-144 is a near field 2 meter receiver with a calibrated, multicolor LED display. The LED display indicates deviation from 0.3 kHz to 5 kHz, and has a 1 watt speaker output for connection to an optional speaker or oscilloscope. The D-144 doubles as a monitor receiver, enabling users to listen to their transmitted signal. Tuning is indicated by an LED that comes on when the D-144 is center-tuned. Packet users will find the D-144 indispensable for setting the deviation of their packet tones, and voice users will appreciate the ability to set their microphone gain controls and subaudible tone levels.

The D-144 is housed in an aluminum enclosure that measures approximately 6-5/8" wide by 3-3/4" deep by 1-3/4" high. The unit operates on 12 VDC at about 300 mA. The price is $139.95, and an optional speaker is $14.95. Availability is stock to four weeks. For further information contact: *RF Applications, Inc., 7345 Production Drive, Mentor OH 44060; (216) 974-1961.* Or circle Reader Service No. 202.

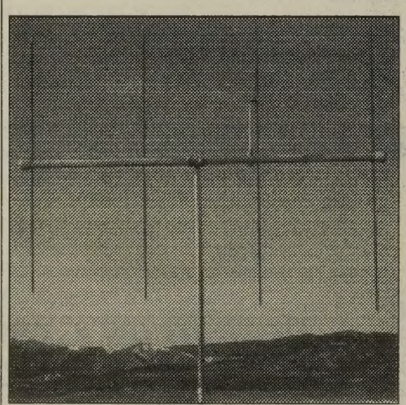
THE TOOL RESOURCE



The convenient and economical Hex-Wik desoldering braid is now available from The Tool Resource. This product works quickly and easily, while safely desoldering components from PC boards and terminals. The braid removes solder quickly so the joint is clean and components are not damaged.

To use the desoldering braid, select a soldering tip slightly wider than the braid. Lay the Hex-Wik braid against the solder connection and apply a freshly tinned tip on top of the braid. Remove the braid and the heat as soon as the solder is absorbed. Cut this portion off and you're ready to go again.

For more information contact: *The Tool Resource, P.O. Box 1106 W. Dundee IL 60118; (708) 468-0849 (phone or FAX).* Or circle Reader Service No. 204.

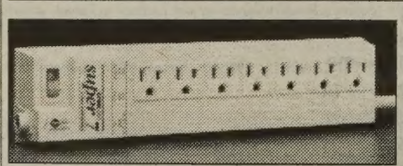


ARROW ANTENNA

Foxhunters will be interested in this new portable 2 meter beam from Arrow Antenna. The model 144-4 has the highest possible gain from four elements on a four-foot boom. It has a surprisingly wide bandwidth of over 6 MHz with less than 1.5:1 VSWR. The elements are made from arrow shafts that screw together through a one-inch-square brushed aluminum boom. The gamma match is unique in that it mounts through the boom, in line with the elements. This gives the antenna a cleaner, straighter pattern, vital for radio direction finding.

This rugged lightweight beauty is only 21 ounces and very portable. The whole thing can be assembled or broken down in two minutes or less without tools.

The model 144-4 is a high quality product; if you are not happy for any reason you may ship it back to the manufacturer within 90 days for a full refund. The price is $65 and it is shipped UPS within the continental US for $5 S&H. For more information, contact: *Arrow Antenna, 1461 Peacock Pl., Loveland CO 80537; (303) 663-5485.* Or circle Reader Service No. 208.

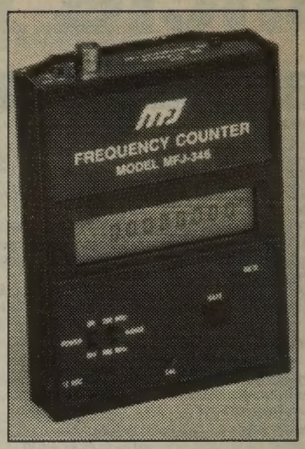


TRIPP LITE

The Spike Bar Super 7 surge suppressor features diagnostic power indicators and high quality surge suppression in one low-cost unit. Three diagnostic indicators display wiring faults, status of protection circuitry, and loss of AC power, assuring complete equipment protection.

The Spike Bar Super 7 has seven spike and noise filtered AC outlets, a seven-foot AC line cord, circuit breaker, and is UL listed. This premium featured unit is protected by Ultimate Lifetime Insurance, which covers both the surge suppressor and and connected equipment from damage *including direct lightning strikes*, up to $5,000.

The suggested retail price is $49.95. For more information, contact: *Tripp Lite, 500 N. Orleans, Chicago, IL 60610-4188; (312) 329-1777, FAX (312) 644-6505.* Or circle Reader Service No. 207.



MFJ ENTERPRISES, INC.

Here is a terrific station accessory with literally thousands of applications! The new MFJ-346 600 MHz 10-digit LCD Frequency Counter displays in large quarter-inch digits that can be easily seen—even in direct sunlight.

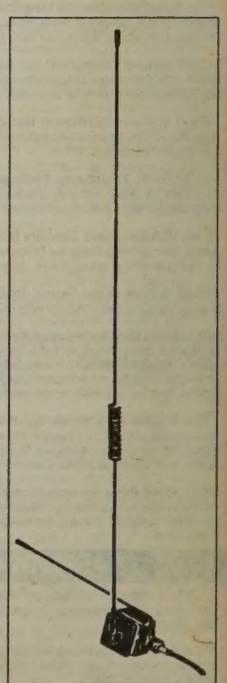
This compact unit can be used for exact frequency measurements of hand-held FM transceivers, and even for measuring mystery frequencies when placed near mystery antennas. It can also measure local oscillator signals in receivers and the oscillation frequencies of classic regenerative receivers. Your imagination is the only limit to the applications for this versatile unit.

The MFJ-346 utilizes high speed ASIC and custom LCD technology.

This counter is powered by a 9V battery, and you can select various frequency resolutions with accuracy of 1 PPM. It comes with an unconditional one-year guarantee. The price is $189.95. For more information, please contact a dealer or: *MFJ Enterprises, Inc., P.O. Box 494, Mississippi State MS 39762; (601) 323-5869, FAX or TELEX (601) 323-6551, or order toll-free at (800) 647-1800.* Or circle Reader Service No. 205.

ANTENNA SALES & ACCESSORIES

You won't need to worry about ground planes when installing the ASA Model 144/440 ATG dual-band mobile antenna. This half-wave on glass 2 meter 2.6 dB/440 MHz 6.3 dB gain antenna was made for cars constructed of Fiberglas *or* metal. No ground plane is needed for optimum performance. The 26" stainless steel whip is copper-coated to dissipate heat and has a black finish. VSWR is less than 2:1.



The whip is easily removable. Mounting is easy with high-tech double-sided adhesive. The antenna passed 110 MPH wind tests. It comes with 14 feet of coax and a PL259 connector. The price is $49 plus $4 S&H within the continental US. (South Carolina residents please add sales tax.) Remount kits are stocked for your convenience. A 2 meter only version is also available, priced at $31 plus S&H. For further information, contact: *A.S.A., P.O. Box 3461, Myrtle Beach SC 29578; (800) 722-2681 or (803) 293-7888.* Or circle Reader Service No. 206.

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FEATURES	Yaesu FT-530	Kenwood TH-78A	Alinco DJ-580	Icom IC-W-21AT
Memory Channels	82	50	40	70
Slide-out Lithium Battery	YES	NO	NO	NO
Dual CTCSS Decoder	YES	NO	NO	NO
Battery Voltage Readout	YES	NO	NO	NO
Automatic CTCSS Tone Search	YES	NO	NO	NO
Transmit Battery Saver (Repeater & Simplex Operation)	YES	NO	NO	NO
Built-In Vox	YES	NO	NO	NO
One Touch Reverse Button	YES	NO	NO	NO
Dual In-Band Receive (V+V, U+U)	YES	YES	NO	YES
Programmable External Speaker Audio	YES	NO	NO	NO
Optional Digital Display Mic with "S" Meter	YES	NO	NO	NO
AM Aircraft Receive	YES	YES	YES	YES

The Best vs. "the rest".

FT-530
Dual Band Handheld

- **Frequency Coverage:**
  2-Meter 130-174 MHz RX
  144-148 MHz TX
  70 cm 430-450 MHz RX/TX
- 4 TX Power levels:
  w/FNB-25: 2.0, 1.5, 1.0, 0.5W
  w/FNB-27: 5.0, 3.0, 1.5, 0.5W
- DTMF Paging and Coded Squelch
- AOT – Auto On-Timer with built-in clock and alarm functions
- IBS – Intelligent Band Select (provides automatic TX band select on scan stop)
- Backlit keypad and display with time delay
- Built-in cross-band repeat function
- APO – Automatic Power Off
- 5 Watts output w/ FNB-27 battery or 12 VDC
- 2 VFO's for each band
- **Accessories:**

NC-42	1-Hour Desk Charger
FNB-25	600 mAh Battery (2 watt)
FNB-26	1000 mAh Battery (2 watt)
FNB-27	600 mAh Battery (5 watt)
FBA-12	6 AA Cell Holder
CSC-56	Vinyl Case w/ FNB-25
CSC-58	Vinyl Case w/ FNB-26/27
E-DC-5B	12 VDC Adaptor
YH-2	Headset for VOX
MH-12A2B	Speaker Mic
MH-18A2B	Lapel Speaker Mic
MH-19A2B	Mini Earpiece Mic
MH-29A2B	LCD Display Mic with Remote Functions
MMB-54	Mobile Mounting Hanger

No other dual band handheld beats the FT-530 on features for performance and ease of use. With the largest backlit keypad available, 82 memories, exclusive Dual CTCSS Decode and AM Aircraft Receive, the FT-530 is simply the best value there is.

Compare for yourself, then forget "the rest." See your dealer for the best dual band handheld you can buy. The FT-530.

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Specifications subject to change without notice. Specifications guaranteed only within amateur bands. Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific details.

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The IC-3230 was designed for the mobile FM'er who wants high performance and ease of use. The 3230 is a **one-touch** transceiver for the most often-used functions. It's simple and safe to use while driving. Main functions are activated with **one-touch action switches.** Hold the same button in slightly longer to access secondary functions— no need to hunt for a separate function switch.

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The color-coded, illuminated controls and the display are laid out the way people naturally use radios: UHF on the right, VHF on the left, each independently controlled. And with the optional **Talk-Back** feature, your eyes never have to leave the road to change frequencies. The 3230's voice synthesizer tells you just where you are! The same option works with **crossband repeat,** which gives your DTMF handheld the range and power of your mobile. TalkBack lets your handheld tell you what frequency your 3230 is set to.

And, of course, **full-duplex operation** means you can use your mobile with the ease of a telephone— including 14 memories, single-button autopatch, autodialing and 911 access.

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ICOM's mobiles aren't just for the road anymore. With the optional PS 45/PS 200 power supply, the fun continues! The PS45 becomes a docking station for your 3230 to slip into and becomes an excellent entry-level base station. Or buy one for home, one for the road, and stay in touch!

IC-3230: A High-Performance Package in an Easy-To-Use Compact.

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